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FORCEnet; Capabilities, Tasks, and Attributes

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13. ABSTRACT (Maximum 200 words.)

The Navy's Network-Centric Warfare program has defined a set of 15 Capabilities to guide development, and Tasks associated with each Capability. Development of these Capabilities will enhance operations over a broad spectrum of warfare areas. Reporting of these enhancements over all affected areas is needed.   The work reported here has developed a structure that relates FORCEnet Capabilities, Tasks, and Attributes to those of three Joint Functional Concepts.   A schema is presented for reporting experiment results and relating them across these Capabilities.

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EXECUTIVE SUMMARY

The relationships between military operational capabilities and the programs responsible for the development of technologies that support those capabilities are complex. This report describes a schema for mapping those relationships. One purpose of the schema is to enable reporting progress in capabilities development across program and capabilities areas, with the ultimate goal to support programmatic decision-making.

The following figure illustrates, simplistically, the structure of the schema. Capabilities development begins with identification of operational gaps, followed by programs designed to fill those gaps, system and process development, experimentation to test developments. and reporting of progress. The schema provides a structured mapping of the relationships between programs and capability areas and uses this mapping reporting across these areas.
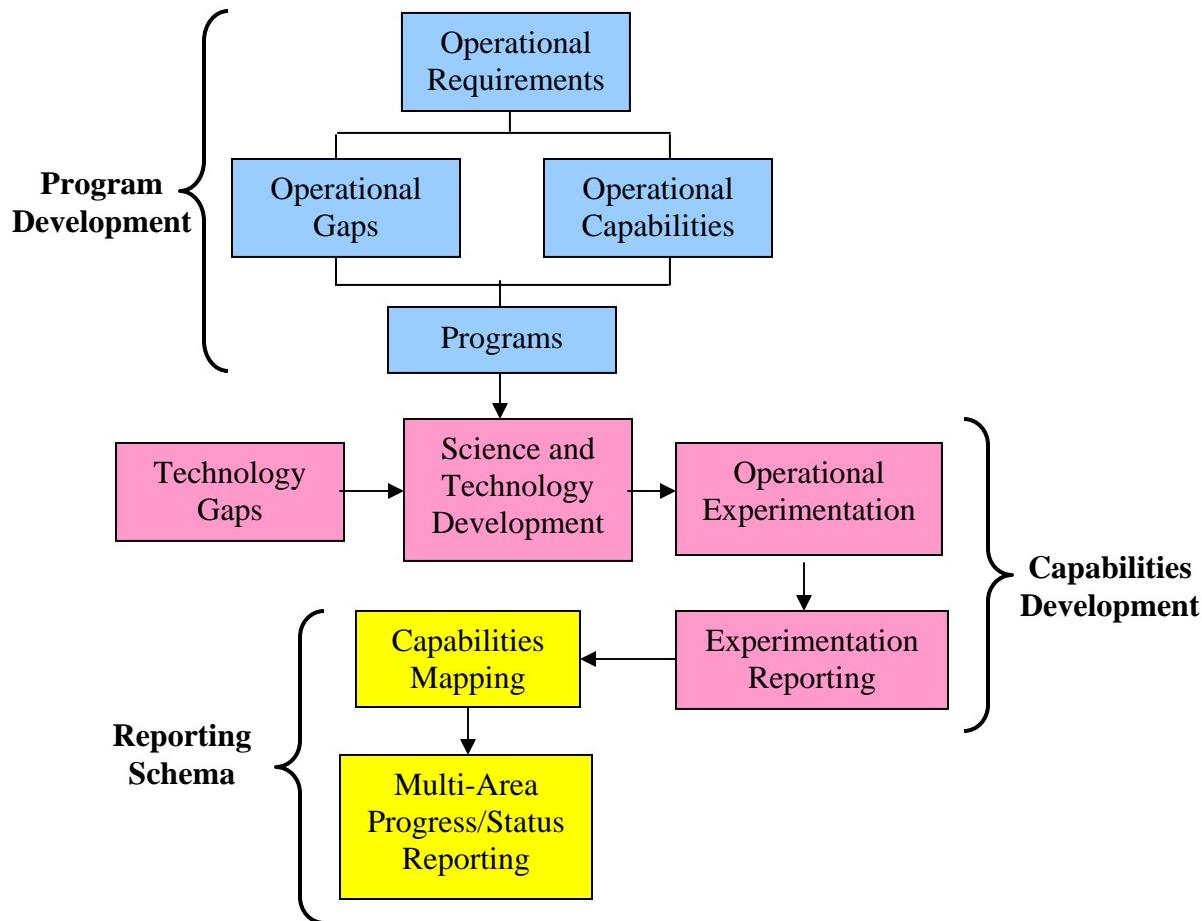
Although not shown, training is an important part of the development process. New capabilities are not realized without training to utilize the new systems and processes.

Contained here are mappings between FORCEnet capabilities and the capabilities described in three JCIDS Functional Concepts: Battlespace Awareness (BA), Command and Control (JC2),

and Net-Centric Environment, (NCE).   Capability mapping results are shown in the following diagram.
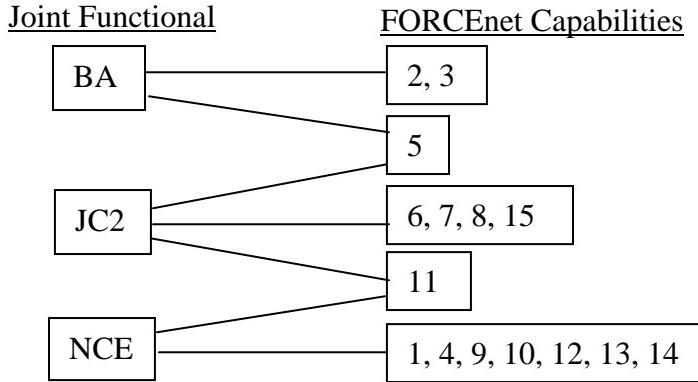
If the same criteria had been used for defining Joint and FORCEnet capabilities the mapping would be one-to-one. This is not the case and is most often not the case when comparing different domains.

A mapping that can be used for results reporting requires examining levels below capabilities, tasks within those capabilities, and this is shown in the body of the report. Multi-level mapping requires determining those levels that can be used for mapping. For this schema they are:

> Functional Capabilities – capabilities required to perform successfully those functions (e.g., Intelligence, Surveillance, and Reconnaissance).

> Operational Tasks – tasks performed by operating forces, executing processes that provide those capabilities (e.g., Battle Damage Assessment). There can be several task levels (sub-tasks).

> Attributes – quantifiable characteristics of task performance (e.g., Timely).

> Measures – specific quantities that provide attribute quantification (e.g., elapsed time, as a timeliness measure, for executing the BDA task).

The structure presented here for mapping between different areas is shown in the following diagram. It is understood that an area will normally contain several capabilities, a capability several tasks (and sub tasks).

The structure reported maps at the task and attribute levels, shown by dotted lines in the following figure. It is understood that mapping may be needed at the sub-task level. The key is that operational tasks must be well defined and sufficiently narrow in scope so that mapping that is essentially one-to-one can be achieved.

Domain-1   Domain-2

Capabilit   Capability

Capability   Capability

Task   Task

Task   Task

Same or
Similar Tasks

Task   Task

Attribut   Same   Attribute
Attribute

Attribut   Attribute
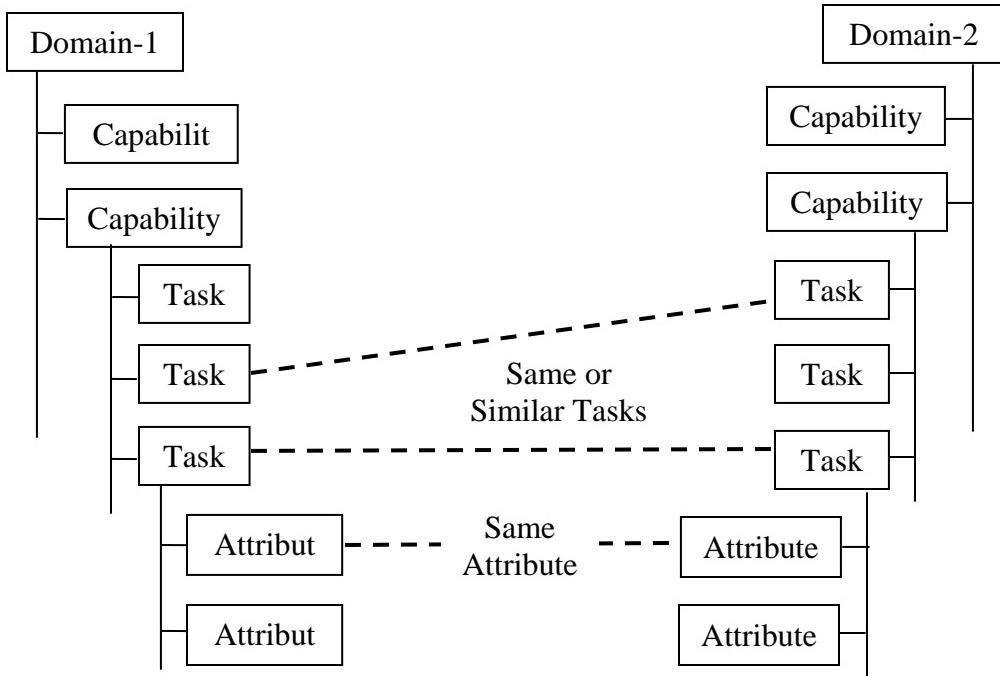
It is also necessary to map attributes because results are presented as measures (attribute quantification). For example, a particular task, e.g. planning, may need to be timely and sufficient (the two attributes).

Schema Summary:
It has been found that adequate mapping of Joint to FORCEnet capabilities is accomplished by using tasks and a single sub-task level.

Attributes have extracted from the three Joint concepts examined and from the capability lists used for Trident Warrior experiments. Attributes have been assigned to the defined FORCEnet tasks and sub-tasks as part of this work and development of the capabilities Annex. Mapping of Joint and FORCEnet attribute has been developed.

These steps have produced a robust schema for relating progress and status between JCIDS and FORCEnet capabilities. The schema can be used for mapping between any areas as long as they contain equivalent or like operational tasks.

Required measures are often produced as results from operational experiments. Applying those results to a given set of capabilities follows essentially the same schema described above. During the experiment planning process, the tasks to be tested are defined, as are their attributes and measures. Mapping of these tasks and attributes to those areas/capabilities to which reporting is to be done is also determined. Once this is done, reporting to the desired venue is essentially automatic.

Mapping from Trident Warrior experiment results to both FORCEnet and JCIDS capabilities has been completed.

A significant advantage of this approach is that reported results, at any level or to any area, are automatically traceable to the data from which they were produced. Such reporting pedigree allows one to assess confidence in the results and even their range of validity.

One difficulty is not discussed here: rollup of results to higher-level attributes and measures. This schema provides a means for relating results across equivalent operational task levels. How to do roll-ups from lower to higher levels is not presented.

1.0 INTRODUCTION

DoD services and joint organizations are in the process of transforming forces to meet the demands of 21st century operations. One foundation of this effort is to develop operational concepts that utilize present and emerging network-centric information processes. Many activities and organizations are developing these concepts and they are only loosely coupled. There are overarching directives, such as CJCSI 3170, which established the policies and procedures of the Joint Capabilities Integration and Development System (JCIDS), but they do not provide sufficient guidance to insure that the many concepts being developed have common methodologies nor that they can be easily integrated.

One of these capabilities development efforts is FORCEnet, which is being carried out by the Navy's Network Centric Warfare Command (NETWARCOM). FORCEnet capabilities are defined and described in the document "FORCEnet, a Functional Concept for the 21st Century", signed out by the Chief of Naval Operations and the Commandant of the Marine Corps. This document presents the needed capabilities and example attributes associated with those capabilities. An Annex to the capabilities document has been prepared that defines tasks associated with the capabilities, attributes for the tasks, and some example measures associated with the attributes.

Three of the Joint Functional Concepts that have been developed under the JCIDS process are closely related to FORCEnet and are described in Section 2 of this report. One of the purposes of the work described in this report is to establish traceable relationships between FORCEnet and these Joint Functional Concepts.

Other relationships between FORCEnet and DoD activities need to be established. One is to the Planning, Programming, Budgeting, and Execution (PBE) process and its implementation by the Navy as the Naval Capabilities Development Process (NCDP). Another is to experimentation. Experimentation is addressed in this report and the NCDP is addressed in an accompanying report.

One goal of concept development, operational capabilities development, systems development, and their supporting experimentation is to provide information that supports the NCDP process. The NCDP focuses on funding support for capabilities to carry out defined operations such as Homeland Security, Strategic Deterrence, Major Combat Operations, and Stability Operations. A basis for assessing these capabilities is development of mission threads (that define operations to be carried out) and architectures for systems and processes (that provide the capabilities to successfully prosecute those threads). Correlation between mission threads and architectures and the schema presented in this report is in development and will be presented in a later report.

This report contains:

- Tasks and sub-tasks that support joint capabilities.

- Tasks and sub-tasks that support FORCEnet capabilities.

- Mapping between these task sets.

- Attribute development and mapping between the areas.

- Task/attribute association.

- A methodology for reporting experimentation results to capabilities and functional areas.

The sum-total of the material in this report provides a robust schema for relating capabilities development and status across functional areas.

This report provides background for the Annex, presenting the methodologies that were used in its development and development material that was not appropriate for inclusion in the Annex. This report does not describe FORCEnet capabilities since those definitions can be found in the functional concept document referred to above. There is considerable overlap, however with the material found in the Annex, because some of that material was developed as part of this project and is needed here for this report to be complete.

2.0 BACKGROUND

For reference purposes, this section provides a limited amount of information on the capabilities described by the Joint and FORCEnet functional concept documents. For complete descriptions, refer to the documents listed below. Also included is some experimentation information to provide the basics of how experiment initiatives are related to these capabilities.

2.1 Joint Functional Areas

The Joint Functional Concepts describe how the future joint force will perform a particular military function. The three that are directly related to FORCEnet are:

- Joint Command and Control (JC2)

- Net-Centric Environment   (NCE)

- Battlespace Awareness (BA)

Reference documents used in this project's development are:

- Joint Command and Control Functional Concept, v1.0, Draft, undated

- Net-Centric Environment Joint Functional Concept, Version 0.95, Office of the Joint Chiefs of Staff, December 30, 2004

- Battlespace Awareness Functional Capabilities Board, Functional Area Analysis, 29 March 2004

Each Functional Area is divided into two distinct sets of capabilities:

JC2	Basic C2 Capabilities	Collaborative C2 Capabilities
NCE	Knowledge Area Capabilities	Technical Area Capabilities
BA	Operational Capabilities	Enabling Capabilities

The capability types within these sets are not exactly the same. In general, the first set has an operational flavor while the second is more technical.

One would expect that the three joint areas would contain capabilities of the following types:

BA	Operational ISR processes.
JC2	C2 processes in support of operations.

NCE   Technical support of C2, situational awareness, information processes, and operations.

Clean distinctions of this type are not made, and this leads to difficulties in mapping capabilities that are discussed in Section 4. One difficulty is that there is considerable overlap between JC2 and NCE, with each including capabilities that rightly belong to the other.

The capabilities listed under each of the three Joint Functional Areas are:

JC2   Basic C2 Capabilities

Monitor and Collect Data
Develop Situational Understanding
Develop Course of Act., Select One
Develop a Plan
Execute Plan, Direction, & Leadership
Monitor Execution & Adapt as Necessary

Collaborative C2 Capabilities

Network
Share Information
Interact
Develop Shared Awareness
Decide in a Collaborative Environment
Synchronize

NCE   Knowledge Area Capabilities

Establish Appropriate Org Relationships
Collaborate
Synchronize Actions
Share Situational Awareness
Share Situational Understanding
Conduct Collab. Decis. Making/Planning
Operate Independently

Technical Area Capabilities

Create/Produce Information
Store/Share/Exchange Information & Data
Establish an Information Environment
Process Data and Information
Employ Geospatial Information
Employ Information
Find and Consume Information
Provide User Access
Access Information
Validate/Assure
Install/Deploy
Operate/Maneuver
Maintain/Survive
Provide Network Services

BA   Operational Capabilities

Command and Control of BA Assets
Execute Collection
Exploitation and Analysis
Model, Simulate and Forecast
Manage Knowledge

Enabling Capabilities

Integrate BA Network
Rapidly Infuse Technology

Each of these capabilities has an associated set of tasks. They are listed in Section 4.

2.2 FORCEnet Capabilities

There are 15 FORCEnet capabilities. In numerical order they are:

Fn1. *Provide robust, reliable communication to all nodes, based on the varying information requirements and capabilities of those nodes.*

Fn2. *Provide reliable, accurate and timely location, identity and status information on all friendly forces, units, activities and entities/individuals.*

Fn3. *Provide reliable, accurate and timely location, identification, tracking and engagement information on environmental, neutral and hostile elements, activities, events, sites, platforms, and individuals.*

Fn4. *Store, catalogue and retrieve all information produced by any node on the network in a comprehensive, standard repository so that the information is readily accessible to all nodes and compatible with the forms required by any nodes, within security restrictions.*

Fn5. *Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.*

Fn6. *Provide each decision maker the ability to depict situational information in a tailorable, user defined, shareable, primarily visual representation.*

Fn7. *Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environment.*

Fn8. *Automate lower-order command and control sub-processes and use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations.*

Fn9. *Provide information assurance.*

Fn10. *Function in multiple security domains and multiple security levels within a domain, and manage access dynamically.*

Fn11. *Interoperate with command and control systems of very different type and level of sophistication.*

Fn12. Allow individual nodes to function while temporarily disconnected from the network.

Fn13. *Automatically and adaptively monitor and manage the functioning of the command and control system to ensure effective and efficient operation and to diagnose problems and make repairs as needed.*

Fn14. *Incorporate new capabilities into the system quickly without causing undue disruption to the performance of the system.*

Fn15. *Provide decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses.*

A significant portion of this report will deal with various mappings between FORCEnet and Joint Functional Area capabilities. Doing this leads to sorting the FORCEnet capabilities into logical groups that initially map as follows:

JC2	to	Fn6	Fn7	Fn8						
NCE	to	Fn1	Fn4	Fn5	Fn9	Fn10	Fn11	Fn12	Fn13	Fn14
BA	to	Fn2	Fn3							

Fn15 is not listed because it is an overarching capability and mapping it to individual joint capabilities is not useful for the purposes of this report. The initial mapping shown above is not sufficient. Improving it requires that Fn5 and Fn11 each be split into two parts, each part corresponding to a particular "domain". This will be explained in Section 4.

2.3 Trident Warrior Experiment Series

Trident Warrior is a series of yearly experiments specifically designed to develop and test FORCEnet capabilities. Each experiment is carried out using operational naval forces. Systems are tested, within a variety of operational processes, both current and developmental.

The experiments are not explicitly designed to specifically test or provide information for a specific FORCEnet capability. Rather, they are designed toward a set of learning objectives. The experiment planning process proceeds along the following steps:

- Define a set of experiment focus areas that match the overall experiment purposes.

- For each focus area, determine objectives that are to be achieved.

- Objectives require a set of associated goals/questions. Design those goals.

- Determine the experiment conditions required to address each goal.

- Determine attributes.

- Determine measures for each attribute that address the goal.

Following these steps is detailed planning to define events, data capture, personnel assignments, etc. Only the steps listed above are germane to this report.

Results produced by these experiments automatically inform the objectives and focus areas for which they were determined. They do not automatically inform FORCEnet or Joint Functional Area capabilities. In order to do that, the mappings that are presented in this report are required. Section 7 will describe the reporting processes.

2.4 Mission Capability Packages

Informing the Navy NCDP process is an important aspect of reporting experimentation results. Mapping to do this is through the Mission Capability Packages (MCPs). The basic mapping between FORCEnet capabilities, MCPs, and Joint Functional Concepts is shown in Figure 1.

Functional Decomposition
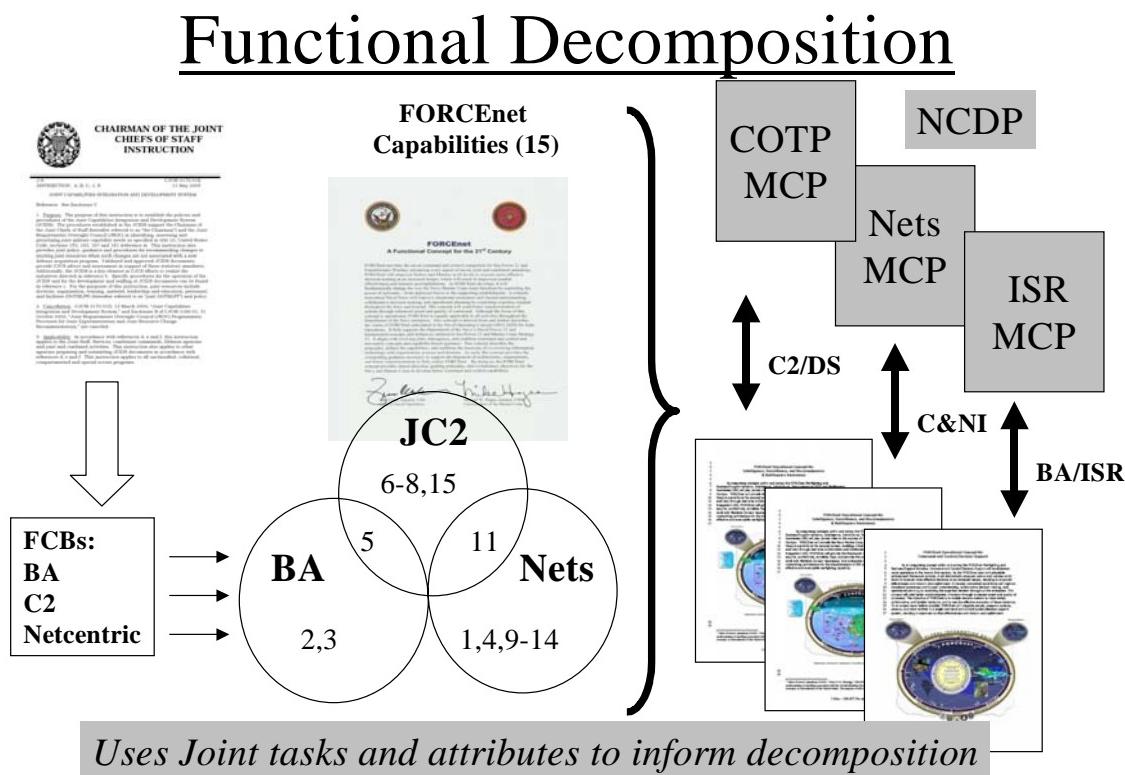
Figure 1. FORCEnet capabilities, MCPs, and Joint Functional Areas Mapping

Mapping to MCPs is not described, only mentioned in this report for completeness. A separate report is being prepared that includes a complete description.

2.5. NCOW Reference Model

The Network Centric Operations and Warfare Reference Model (NCOW RM) is an important reference for FORCEnet tasks. It was not used directly for this project, but it is playing a major role in the development of an integrated architecture for FORCEnet. The NCOW RM and the FORCEnet Concept Annex each define a hierarchy of capabilities, tasks, or activities. Unfortunately, the correspondences between the two structures are not always between corresponding levels, which complicates the mapping. This will be the subject of a separate project, undertaken with architecture development.

Appendix C presents a spreadsheet showing comparison of NCOW RM activities and tasks to FORCEnet capabilities and tasks. This information was produced by a separate NETWARCOM project and is included here as a reference.

3.0 ATTRIBUTE DEVELOPMENT

An attribute is a quality or characteristic of a process, system, or human. The focus of the work described here is military operations so attributes are those appropriate to determining operational capabilities. Attributes used here are those that describe the ability of processes, systems, and humans to perform their ascribed operational functions. The functions that are performed during military operations are very broad and numerous, as are the applicable attributes.

This section describes the attribute sources that have been used, the process for merging them into a single set, and how mapping between the sources is preserved for use in reporting experimental results.

3.1 Attribute Sources

Attributes have been used from five primary sources:
1. Joint Command and Control Functional Area
2. Network Centric Environment Functional Area
3. Battlespace Awareness Functional Area
4. FORCEnet Capabilities for the 21st Century
5. Trident Warrior Experiment, TW05 initiatives

Additional secondary sources were:
Silent Hammer experiment report
FORCEnet MOE Analysis, SAIC, Oct 2004
FORCEnet Analysis: Status and Plans, Bell, Mar 2003

Sources 4 and 5 were combined into a common FORCEnet source (see Table 1). The secondary sources were used to check the completeness of the FORCEnet source.

3.2 Attribute Semantic Set

The dictionary contains many words that are essentially attributes. Many of them have meanings that are close to being the same, with small nuances being the difference between them. Whether or not these nuances are important depends on the context, or situation, in which they are being used. Our desire here is to have the minimum number of attributes that are needed for describing military operational capabilities. Thus, in those cases where we judge attributes to have essentially the same meaning, we have removed all but one of them from the final list. The final list is designated the "Semantic Set".

The original attribute numbers are used to trace which attributes have been deleted from the semantic set and also which attribute is used in its place. The scheme is as follows:

- If an attribute from the all attribute set isn't used, it isn't listed in the semantic set and a number appears in its place.

- The number in the semantic set cell is the number of the attribute used in its place.

- When numbers appear in the Synonymous column, they are the numbers of the attributes that have been absorbed into the one indicated.

This numbering scheme provides a map from an attribute in the semantic set back to its source(s). This mapping is one of the components in relating experiment results to the various capabilities to which they apply.

3.3 Attribute Map

Table 1 contains the attributes from all sources, the combined attribute set, and the reduced/semantic set that is the final result of attribute development. The table column titles and their contents are:

Col 1: "FORCEnet All Source" – Attributes obtained from sources 4 and 5 and the secondary sources.

Cols 2, 3, & 4: "JCIDS"; "BA", "JC2", and "NCE" – Attributes obtained from the Joint Functional Area documents.

Col 5: "#" – Sequential number used for attribute numbering and tracking.

Col 6: "All Attributes" – Alphabetical list of attributes obtained from all sources.

Col 7: "Synonymous #" – Indication, by number, of attributes that are judged to be synonymous with each other.

Col 8: "Semantic Set" – Final set of attributes to be used. Synonymous attributes have been collapsed into a single attribute (see explanation in Section 3.3).

## Table 1.	FORCEnet - JCIDS Attribute Comparison

FORCEnet All Source	JCIDS			#	All Attributes	Synonymous #	Semantic Set
	BA	JC2	NCE				
Accessible		Accessible	Accessible	1	Accessible	13	Accessible
Accurate		Accurate	Accurate	2	Accurate	74	Accurate
				3	Adequate		Adequate
Adaptive		Adaptable		4	Adaptable		Adaptable
Agile	Agile		Agile	5	Agile		45
Ambiguous				6	Ambiguous		Ambiguous
Applicable				7	Applicable		81

				No.	Term			
Appropriate		Appropriate	Appropriate	8	Appropriate			81
Assured			Assured	9	Assured		Assured	
			Authentic	10	Authentic		Authentic	
Automatic				11	Automatic		Automatic	
Autonomous			Autonomous	12	Autonomous	49	Autonomous	
			Available	13	Available			1
Capacity				14	Capacity		Capacity	
Clear				15	Clear	112	Clear	
Compatible				16	Compatible		Compatible	
Complete		Complete	Complete	17	Complete	19, 73, 100	Complete	
		Compliant		18	Compliant		Compliant	
Comprehensive				19	Comprehensive			17
			Confidential	20	Confidential			95
		Congruent		21	Congruent		Congruent	
Connected				22	Connected		Connected	
Consistent		Consistent SU	Consistent	23	Consistent		Consistent	
Continuous				24	Continuous		Continuous	
			Controllable	25	Controllable		Controllable	
		Coordinated		26	Coordinated		Coordinated	
		Correct	Correct	27	Correct		Correct	
Correlated				28	Correlated		Correlated	
Coverage				29	Coverage			80
Current		Current		30	Current		Current	
			Deployable	31	Deployable		Deployable	
		Dispersed C2		32	Dispersed			33
			Distributed	33	Distributed	32	Distributed	
			Diverse	34	Diverse		Diverse	
Duplicative				35	Duplicative		Duplicative	
			Dynamic	36	Dynamic			45
Economical				37	Economical			39
		Effective		38	Effective		Effective	
Efficient				39	Efficient	32, 44, 125	Efficient	
			Employable	40	Employable			114
Enhanced		Superior Decisions		41	Enhanced		Enhanced	
		Extended		42	Extended		Extended	
Fast				43	Fast			69
Fewer				44	Fewer			39
Flexible		Flexible	Flexible	45	Flexible	5, 36, 82	Flexible	
				46	Frequent		Frequent	
Good				47	Good			66
Graceful Degr.				48	Graceful Degrad		Graceful Degrad	
Independent				49	Independent			12
Innovative		Innovative	Innovative	50	Innovative		Innovative	
Full Integrated		Full Spect. Integ.	Integrated	51	Integrated		Integrated	
Integrity			Integrity	52	Uncompromized		Uncompromized	
Interoperable			Interoperable	53	Interoperable		Interoperable	
Intuitive				54	Intuitive		Intuitive	
Latency				55	Latency		Latency	
Layered				56	Layered		Layered	
Learning				57	Learning		Learning	
Lethal				58	Lethal		Lethal	
		Maintainable	Maintainable	59	Maintainable		Maintainable	
			Manageable	60	Manageable		Manageable	
			Maneuverable	61	Maneuverable		Maneuverable	

		Mobile		62 Mobile		
Modular			Modular	63 Modular		Modular
Networked				64 Networked		Networked
			Non-Repudiated	65 Non-Repudiated		Non-Repudiated
Open System				66 Open System		Open System
Orderly				67 Ordered		Ordered
Permanent				68 Permanent		70
Permissive				69 Permissive		Permissive
Persistent	Persistent			70 Persistent	68	Persistent
Pertinent				71 Pertinent		81
Pervasive				72 Pervasive		Pervasive
Polymorphic				73 Polymorphic		17
Precise	Precise			74 Precise		2
				75 Protected		95
Quality	Quality	Quality	Quality	76 Quality	47	Quality
Quickly				77 Quickly		79
	Range			78 Range		Range
Rapid				79 Rapid	43, 77, 99	Rapid
Reach	Reach	Reach	Reach	80 Reach	29	Reach
		Relevant	Relevant	81 Relevant	7, 8, 71	Relevant
			Reconfigurable	82 Reconfigurable		45
			Redundant	83 Redundant		Redundant
Reliable				84 Reliable		88
			Repairable	85 Repairable		Repairable
Resilient		Resilient	Resilient	86 Resilient		88
Responsive		Respon/Tailor Orgs	Responsive	87 Responsive		Responsive
Robust		Robust Networking	Robust	88 Robust	84, 86, 89, 104	Robust
			Rugged	89 Rugged		88
			Scalable	90 Scalable		Scalable
Seamless				91 Seamless		Seamless
Self-Contained				92 Self-Contained		Self-Contained
Self-Healing				93 Self-Healing		Self-Healing
Self-Organizing				94 Self-Organizing		Self-Organizing
Secure	Secure			95 Secure	20, 75	Secure
Sharable	Sharable	Shared Understand.		96 Sharable		Sharable
		Shared Quality Info				
		Simultan. C2 Proc.		97 Simultaneous		Simultaneous
Sortable				98 Sortable		Sortable
Speed of Decis				99 Speed of Decis		79
Sufficient				100 Sufficient		Sufficient
				101 Superior		Superior
Standard				102 Standard		Standard
Structured				103 Structured		Structured
Survivable		Survivable	Survivable	104 Survivable		88
			Sustainable	105 Sustainable		Sustainable
Synchronous		Flexible Synch.		106 Synchronous	133	Synchronized
Tailorable				107 Tailorable		Tailorable
Timely	Timely	Timely	Timely	108 Timely		Timely
			Traceable	109 Traceable		Traceable
			Transportable	110 Transportable		Transportable
			Uncompromized	111 Uncompromised		Uncompromised
Understandable				112 Understandable		15
		Upgradeable	Upgradeable	113 Upgradeable		Upgradeable
Usable		Usable	Usable	114 Usable	40	Usable

User Defined				115 User Defined	User Defined
User Friendly				116 User Friendly	User Friendly
Value Added				117 Value Added	Value Added
Primarily Visual			Visible	118 Visual	Visual
The following attributes are primarily for human and group capabilities. **Above attributes can also be used for humans and groups when appropriate**					
Competent			Competent	119 Competent	Competent
Confident			Confident	120 Confident	Confident
Collaborative				121 Collaborative	Collaborative
Compliant				122 Compliant	Compliant
Cooperative				123 Cooperative	Cooperative
Diverse				124 Diverse	34
Efficient				125 Efficient	39
Engaged				126 Engaged	Engaged
Experienced				127 Experienced	Experienced
Interdependent				128 Interdependent	Interdependent
Knowledge Flow				129 Knowledge Flow	Knowledge Flow
Risk Accepting				130 Risk Accepting	Risk Accepting
Size				131 Size	Size
Structured				132 Structured	Structured
Synchronized				133 Synchronized	106
Trusting				134 Trusting	Trusting
Trusted				135 Trusted	Trusted
			Willing	136 Willing	Willing

3.4 Human/Group Attributes

Attributes that apply specifically to human operators and groups of humans or organizations have been separated from the other attributes and are shown at the bottom of Table 1. There are attributes in the main list that can also apply to humans and organizations, but whether they do so is not indicated. This separation of human/organization attributes is done because special care is needed when ascribing characteristics to humans, when judging their performance. Having a well-defined and understood set of attributes that will be used helps in performing adequate judgments.

Those human-system interaction attributes that apply to how well a system meets human needs are not in the human/group list, rather they are contained in the main list.

There is nothing sacrosanct about the attributes presented here. They have been checked by several types of subject-matter-experts, including experts in human factors. But, it is well known that different groups, when faced with the task of defining attributes and/or measures, will often come up with sets that are not identical even though many elements will be the same. This is a result of the richness of human language.

This list is the one that is currently being used for Trident Warrior and that appears in the Annex to the FORCEnet functional concept document. After Trident Warrior 05 the list will be examined in light of lessons-learned from the experiment and modified as necessary.

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4.0 TASK DEVELOPMENT AND MAPPING

4.1 Task Domains

The FORCEnet functional concept document lists six "dimensions". Dimension is an unfortunate choice of words due to its common use to indicate axes or quantities that define components of a functional relationship or space. The more accepted term "domains" is used here. The listed dimensions are:

- *Physical*: the various platforms, weapons, sensors, and other entities on the operating end of FORCEnet.

- *Information Technology*: the communications and network infrastructure through which these entities interact.

- *Data*: the common structure and protocols for information handling.

- *Cognitive*: human judgment and decision making and the human-computer interfaces that
- support them.

- *Organizational*: the new force structures and working relationships that will be made possible by FORCEnet.

- *Operating*: the emergent methods and concepts by which forces and other organizations will accomplish their missions due to the capabilities provided by FORCEnet.

This is a cumbersome set to use for this work. Note that physical includes sensors, which are information providers, and are also information technology elements. Human-computer interfaces are included under cognitive and they are part of information technology. Such overlaps make the dimensions set difficult to use. We compress them into four separate domains that make up the essential elements of operations and their network-based support. They are:

- *Physical*: All physical systems, excluding humans, that support the information structure.

- *Informational*: Data and information that is flowing through the physical structure and made available to humans or for machine-to-machine use.

- *Cognitive*: All processes that transform information into awareness and understanding, primarily human processes.

- *Organizational*: Processes performed by groups of humans, the SOP, TTP, and CONOPS that support/define those processes, whether by co-located or distributed groups, including collaboration.

Some discussions of network-centric warfare refer to the fourth domain a social rather than organizationsl. In what follows the labels P, I, C, and O will be used to indicate task domains.

4.2 Joint Functional Concept Tasks

Each of the Joint Functional Concepts documents lists tasks under each capability. These capabilities and tasks are shown in Table 2. Capabilities are in bold, the tasks under them in normal format. The domain of each task is shown.

Table 2. Joint Functional Areas Capabilities and Associated Tasks

NCE Technical Area Capabilities		NCE Knowledge Area Capabilities	
Create/Produce Information		**Establish Appropriate Organizational Relationships**	
Collect Data	P	Deal with Flexible Authority Relations	O
Transform/Process Data Into Information	I	Maintain Flexible Attitudes to Power & Authority	O
Store/Share/Exchange Information & Data		Obtain/Maintain Understanding of Cdr's Intent	O
Tag Information	I	Flexibly Adapt to Changing Operational Needs	O
Post/Publish Information	I	**Collaborate**	
Share Stored Information	I	Effectively Collaborate with Other Entities	O
Advertise Information	I	Overcome Orgaz/Cul;tural Limits to Collaboration	O
Stage Content (Smart Store)	I	Establish Trust in Decisionmaking Collaboration	O
Archive	I	**Synchronize Actions**	
Collaborate	C	Flexibly Adapt Act to Take Advantage of Oppor.	O
Message	I	Flexibly Adapt Act to Minimize Impact of Threats	O
Establish an Information Environment		**Share Situational Awareness**	
Establish Criteria for Storing and Sharing	C/I	Achieve Situational Awareness	C
Share Access Across Areas	P	Communicate SA to Other Decisionmakers	C
Support Enterprise-Wide and COI-Specific Applications	I	Simultaneously Process Multiple Source Inputs	I
Support Dynamic, Priority-Based Resource Allocation	C	**Share Situational Understanding**	
Process Data and Information		Use Multiple Methods to Achieve SU	C
Support Mediation/Translation Services	I	**Conduct Collab Decisionmaking/Planning**	
Correlate and Fuse Information	I	Achieve Higher Quality SU via Multiple Means	C
Process Information	I	Comm Understandings to Other Decisionmakers	C
Employ Geospatial Information		Utilize Virtual Reality Train, Wargaming, & Exerc	O
Link Geographic Info to Underlying Database	C	Make High Quality Decisions	O
Provide Layering and Drill-Down	C	**Operate Independently**	
Employ Information		Know Tasks and Teams Assigned to Tasks	O
Display Information	I	Know Available Assets Enterprise-Wide	I
Enable Machine-to-Machine Information sharing	I	Interact Effectively with DSTs in a Collab Environ	O
Find and Consume Information		Interact/Accept Inputs from Non-Traditional CoIs	O
Train Using Simulation and Mission Rehersal	C		
Discover/Search	C		
Pull/Retrieve/Access	C		
Subscribe	I		
Perform Intelligent Search/Smart Pull	C		
Consume Information	C		
Provide User Access			
Support Role-Based Access Control	C		
Support Strong Authentication	C		

Access Information

Supprot Multi-Level Security	I
Share Across Security Areas (Coalition, HLS)	I

Validate/Assure

Restore/Recover	I
Assure Information	I
Validate Information	I
Determine an Information Pedigree	I
Develop Trust in the Information	C

Install/Deploy

Rapidly Deploy/Employ Robust Connectivity Froward	P
Tailor to Specific Capabilities	I
Function Under Range of Infrastructure and ROE	I
Dynamically Plan Net Architecture Development Process	C

Operate/Maneuver

Self-Synchronize	C
ID & Maintain Awarenes all Nodes All Time	I
Wargame the Network	C
Operate Without Geographical Constraints	O
Support all Ops and Transitional States Along the ROMO	O
Manage Assured Access/Denial	C
Provide ad-hoc Copalition Connectivity	P
Manage Continuity and Restoration of Operations	O/P
Provide Timely and Reliable Delivry of Information	I

Maintain/Survive

Detect and Defend Against logical Attack	C
Dynamically Re-Route Services	C
Degrade Gracefully and Contain Cascade Failures	C
Cpntinue Essential Operations in Degraded Environments	C
Prioritize Data Flows from Key Databases/Backups	C
Acquire Additional Network Resources on Demand	P

Provide Network Services

Connect with All Assets	P
Connect and Share Info Among Interagency/Coalition/IO/NGO	I
Easily Search, File, Transfer, Comm., Support Net Taxonomy	I/P
Archive Large Amounts of Data	I
Inform/Update Chain-of-Command of Network Status	C
Support Separate Constellations of COIs	C/O
Support Gepgraphically Transitioning Nodes	C/O

Collaborative C2 Capabilities		**Basic C2 Capabilities**	
Network		**Monitor and Collect Data**	
Be Networked	O	Develop an Operational Net Assessment	I
Comprehensively Connect the Force	P	Identify and Track Blue/Red/Gray Forces	I
Utilize Secure and Robuse Communications	I	Sassess Countermeasures	C
Employ Network Centric Methods	C/I	Provide Current and Accurate Data	I
Protect Sensors Information & Info Networks	I	**Develop Situational Understanding**	
Link the Force in Time and Purpose	C	Develop Situational Understanding	C
Conduce Simultaneous C2 Functions	O	Achieve Global Situational Awareness	C
Share Information		Develop Near Real-Time Intelligence	C

Be Decentralized	O	Develop Situational Awareness	C
Be Adaptable	O	Access Immediate Data	I
Access Data from All Relevant Sources	I	**Develop Courses of Action and Select One**	
Share Collected Information	I	Discern and Follow Commander's Intent	O
Access Horizontaly & Vert Integrated Info	I	Be Creative	C
Interact		Provide the Means to Act on Provided Information	O
Be Decentralized	O	Accurately Predict Events	C
Be Adaptable	O	Have Timely, Relevant, Decisionmaking Info	I
Interact with Interagency & Foreign Entities	O	**Develop a Plan**	
Interact on a Fully Integrated Syst of Global Coms	O	Develop a Plan Including Pre/Post Conflict Effects	O
Develop Shared Awareness		Dev a Plan Based on Mission Anal & Cdr Intent	O
Be Decentralized	O	Precisely Derive Adversary Courses of Action	C
Be Adaptable	O	Select a CoA Based on Capabilities Assessment	O
Achieve Shared Awareness	C	**Execute the Plan, Provide Direct. and Leadership**	
Achieve a COP	C/I	Develop and Sustain Unity of Command	O
Develop Shared Understanding		Provide Leadership	O
Be Expeditionary	O	Empower Lower Echelons	O
Be Decentralized	O	Command Throughout Echelonw	O
Be Adaptable	O	**Monitor Execution and Adapt as Necessary**	
Improve Shared Understanding	C	Assess Changes in Adversary's Systems	C
Maintain Shared Understanding	C	Develop, Maintain Adaptive Command Processes	O
Decide in a Collaborative Environment		Develop "Observables" for Assessment	C
Collaboratively Plan	O	Provide Feedback on Operations	O
Employ Discourse with Subbordinates	O	Assess Decisions	O
Employ a Globally Deployed Collab Plan Environ	O	Achieve Desired Effects	O
Orchestrate in a Collaborative Planning Environ	O	Conduct Effects-Based Operations	O
Collaborate on Commander's Intent	O	Re-focus Decisions Based On Adversary Actions	O/C
Synchronize			
Be Expeditionary	?		
Be Decentralized	O		
Be Adaptable	O		
Employ the Appropriate Joint Capabilities	O		
Apply Coalition Resources	O		
Employ Combined Forces	O		
Apply Interagency Resources	O		
Synchronize	O		
Conduct Joint Fires	O		
Self-Synchronize	O		

BA Operational Capabilities		**Battlespace Awareness Enabling Capabilities**	
Command and Control of BA Assets		**Integrate BA Network**	
Synchronize ISR with operations	O	Allow for quality BA information flow	I
Task and dynamically re-task assets	C	Allow for timely BA information flow	I
Monitor/track assets & their activities	I	Allow for secure BA information flow	I
Plan	O	Allow for ubiquitous BA information flow	I
Assess	C	Allow for rapidly deployable BA network	P
Execute Collection		**Rapidly Infuse Technology**	
Gain access	P	Allow for rapid insertion of new technology	I
Surveil broad areas synoptically	I	Allow for rapid restructuring of BA structure	I

Focus/stare on targets of interest	**I**
Find, identify, and track	**I**
Employ human resources	**?**
Employ open source resources	**I**
Measure & monitor environmental conditions	**I**
Exploitation and Analysis	
Recognize targets	**C**
Distribute processing	**I**
Information fusion	**C**
Enable analyst collaboration	**C**
Conduct distributed archive	**I**
Collaborate between analytic centers	**O**
ID Red patterns of behavior	**C**
Defeat denial & deception	**C**
Model, Simulate and Forecast	
Auto-populate models & simulations	**I**
ID enemy courses of action	**C**
Integrate adversary & friendly information	**I**
Include cultures, social issues, & resources	**C**
Manage Knowledge	
Smart push/pull information	**I**
Share plan visibility	**I**
Allow producer interactions	**I**
Maintain an open archive	**I/P**

4.2.1 *Joint Capability and Task Irregularities*

It would be structurally ideal if the tasks under each capability were all from the same domain. In most cases the tasks are in one domain or span two adjacent domains. In some cases three domains are spanned. When three are found it indicates that the capability should be broken up into two or more so there is more consistency of type for the tasks within a capability.

A greater structural difficulty is that there are overlaps at the capability level. The following are the most significant cases:

- The Collaborative C2 Capability "Network" is, as its name states, an NCE capability.

- A significant number of the NCE Knowledge Area Capabilities naturally belong to JC2, such as Collaborate, Share Situational Awareness, Share Situational Understanding, Conduct Collaborative Decision-Making/Planning.

- Some of the Network tasks under Collaborative C2 Capabilities belong to NCE, such as the task Comprehensively Connect the Force.

These structural ambiguities may arise from the overlaps noted previously among the Joint Functional Concepts. Our suggestion that BA be regarded as an operational concept and the others as supporting functions leads to the following:

- NCE capabilities provide physical network and information support to the higher level JC2 and BA capabilities.

- JC2 capabilities deal with processes/tasks that provide collaboration, situation awareness and understanding, planning, decision-making, etc. that support operations.

- BA is an ISR function that is operational in nature. NCE and JC2 provide support to carry out that function.

Such distinct definitions would structurally prevent the overlaps noted above. Section 4.4 shows how these overlaps affect mapping tasks between the Joint Functional Area tasks and FORCEnet tasks.

4.3 FORCEnet Tasks

Table 3 lists the assigned tasks for each of the FORCEnet capabilities. This task list is not the final set presented in the Annex but an earlier version used in this report so that the process of task development can more easily be shown. Shortened versions of the capability titles are used for convenience.

The domain and type of each task are also shown. The domains are those listed previously. Type indicates whether the task is an operational action/activity or a supporting task that enables operational activities.

As is the case for the Joint Functional Concepts, tasks within a FORCEnetcapability span one to three domains, but the consistency is better for FORCEnet. The types of tasks included within a capability are much more consistent. In only a few cases does a capability contain both enabling and operational tasks.

Table 3. FORCEnet Task's and their Level and Type

Domain: **P** = Physical **I** = Informational **C** = Cognitive **O** = Organizational

Type: **E** = Enabling (supporting) **A** = Operational Action or Activity

FORCEnet Capabilities and Tasks	Domain	Type
Fn1 Communications all Nodes	**P**	
Access the Network (Provide)	**P**	**E**
Publish presence/identity & services availability	**P**	**E**
Publish and subscribe to info on the network	**P**	**E**
Produce redundant communication channels	**P**	**E**
Identify all nodes on the network	**I**	**E**
Ensure network availability and reliability	**P**	**E**

	Provide sufficient quality-of-service to all nodes	P	E
Fn2	**Provide Blue Information**	I	
	Report own ID, location, intentions, and status	I	A
	Update own information on a timely basis	I	A
	ID for any node where any other plots location	I	A
	ID, calculate, report non-reporting friendly units	I	A
Fn3	**Provide Red Information**	I	A
	Collect/publish everything	I	A
	Provide continuous surveillance of everything	I	A
	Provide combat assessment	C	A
	Provide and task collection assets via network	C	A
Fn4	**Store/retrieve all information**	I	
	Store information	I	E
	Establish metadata registries	I	E
	Establish data/metadata standards	I	E
	Catalogue information	I	E
	Ensure storage redundancy	P	E
	Retrieve information	I	E
	Provide info in compliance with standards	I	E
Fn5	**Process, sort, analyze, etc., information**	I	
	Process data	I	A
	Sort information	I	A
	Evaluate information	C	A
	Analyze information	C	A
	Synthesize information	C/I	A
	Correlate reports over time	I	A
	De-conflict multiple reports	C	A
	Produce intelligence from combat info & other sources	C	A
Fn6	**Provide decision makers tailorable situation info, primarily visual**	I	
	Represent information visually	I	E
	Represent information aurally	I	E
	Correlate elements of visual, aural, other, information	C	A
	Create user-defined situational representations from common data	C	A
	Represent information temporally	I	E
Fn7	**Provide Collaborative environment to distributed decision makers**	O	
	Share plans and complex information products	O	A
	Update information products in real-time	I	E
	Integrate/synchronize multiple inputs, modes, media	C	A
	Form distributed teams or communities of interest	O	E
	Collaboratively create commonly-alterable work products	O	A
	Integrate diverse mission-planning systems into single session	O	A
	Manage collaborative sessions	O	A
Fn8	**Automate Lower-Order C2 Sub-Processes Automated Aids**	C	
	Search for Desired Information or Patterns as Specified by Users	C	E
	Provide automated simulations	C	E
	Provide targeting solutions	C	A
	Provide alerts based on user-defined thresholds	C	E

	Recognize temporal, spatial, content, others, patterns	**C**	**A**
	Suggest changing user preferences based on usage patterns	**C**	**E**
	Make assertions about information patterns	**C**	**A**
	Project movement patterns, trends, and possible outcomes	**C**	**A**
	Aggregate data into larger groupings	**C**	**E**
	Generate auto-routing, navigation solutions, etc. for ships and aircraft	**C**	**A**
Fn9	**Provide Information Assurance**	**I**	
	Authenticate all information and sources	**I**	**E**
	Protect all info systems against disruption, denial, degradation, and destruction	**I**	**E**
	Identify disruption, denial, degradation, and destruction of information	**C**	**E**
	Identify disruption, denial, degradation, and destruction of information systems	**C**	**E**
	Mitigate effects of disruption, denial, degradation, and destruction of information and systems	**C/I**	**E**
Fn10	**Function in Multiple-Security Domains and Levels, Manage Dynamically**	**I**	
	Identify clearance of any network node	**I**	**E**
	Track classification of all information	**I**	**E**
	Correlate clearance with classification in any situation	**I**	**E**
	Control access to information as needed	**I**	**E**
	Sanitize or downgrade classified info to lower security as appropriate	**I**	**E**
Fn11	**Interoperate with C2 Systems of Different Types and Sophistication**	**I/C/O**	
	Establish C2 systems standards	**C**	**E**
	Comply with C2 system standards	**C**	**E**
	Translate between different systems formats and protocols	**I**	**E**
	Provide system interfaces as network services	**P**	**E**
	Incorporate non-DoD elements into Joint C2 Processes	**C**	**E**
Fn12	**Allow Individual Nodes to Function Temporarily Disconnected from Network**	**I/C/O**	
	Optimize communications with limited or interrupted throughput	**P**	**E**
	Prioritize info requirements in order of importance	**C**	**A**
	Interpolate/extrapolate patterns based on limited data	**C**	**A**
	Provide to any node the most recent location information	**I**	**E**
Fn13	**Monitor and Manage the Functioning of the C2 System, Diagnose, Repair**	**P**	
	Monitor systems usage and performance	**P**	**E**
	Allocate and reallocate C2 resources to network services	**P**	**E**
	Manage network accounts	**P**	**E**
	Provide and manage core network services	**P**	**E**
	Reroute info based on load, damage, performance, etc.	**P**	**E**
	Identify the need to intervene in C2 system performance	**C**	**E**
	Suffer C2 system degradation gracefully.	**P**	**E**
Fn14	**Incorporate New Capabilities without Disruption to System Performance**	**P**	
	Incorporate new technologies	**P/I/O**	**E**
	Adopt new doctrine and TTP	**C**	**E**
	Create new organizations	**O**	**E**
Fn15	**Provide Decision Makers Ability to Make Quality Decisions Under All Conditions**	**C/O**	
	Make sense of complex situations	**C**	**A**
	Make decisions	**C**	**A**
	Direct action	**O**	**A**
	Monitor execution	**C**	**A**

4.3.1 *FORCEnet Capability and Task Irregularities*
The irregularities described here are not meant to imply that there is something wrong with the FORCEnet capabilities. We discuss them to indicate how inconsistencies make mapping of tasks from one venue to another difficult.

Fn14 is a good example of the types of inconsistencies encountered. It deals with adoption of new technologies and its included tasks span the full range of domains:
- The task "incorporate new technologies" is somewhat indeterminate;
  - It could be physical, dealing with the physical installation.
  - It could be informational, dealing with the use of those technologies to provide information (that interpretation isn't as likely).
  - It could be cognitive, dealing with human use of those systems for SA and decision-making.

- "Adopt new doctrine and TTP" is primarily cognitive with an organizational component.

- "Create new organizations" is clearly organizational.

There is nothing inherently wrong with having a range of task domains within a capability. Because this occurs for both the Joint and FORCEnet concepts, however, the mapping between them becomes fairly complex.

Fn5 and Fn11 are difficult cases:

- Fn5 deals with processing information and it needs to be mapped to both NCE and BA.

- Fn11 deals with C2 system interoperability and it needs to be mapped to both NCE and C2.

In order to accomplish mapping, it has been necessary to divide both Fn5 and Fn11 into two parts. This will be shown in the next sections.

4.4 Task Mapping Methodology and Sub-Tasks

The first thing that must be done for task mapping is to adopt common semantics. FORCEnet has 15 tasks and a relatively small number of tasks in each. The counts are:

	Capabilities	Tasks
FORCEnet	15	85

BA, NCE, and JC2 use slightly different semantics, have two each capability categories and the following totals of capabilities and tasks:

	Capability Categories	Capabilities	Tasks
BA	2	7	35
NCE	2	21	85
JC2	2	13	70

There is some overlap between the Joint and FORCEnet sets, and in both sets there are tasks that are not included in the other. In the course of the mapping, tasks from the joint concepts have been incorporated into the FORCEnet set where there was no corresponding FORCEnet task. Tasks that are missing from the joint areas have been identified but are not reported here.

In order to do the mapping, the following adjustments to terms have been used:

Joint	FORCEnet		Terms Used
Capability Category	Capability	>	Capability
Capability	Task	>	Task
Task		>	Sub-Task

Note that almost all additions made to the FORCEnet task list were made at the sub-task level.

As was discussed in Section 2, the starting point for task mapping with the following identifications:

Initial Mapping

- JC2   to   Fn6   Fn7   Fn8
- NCE   to   Fn1   Fn4   Fn5   Fn9   Fn10   Fn11   Fn12   Fn13   Fn14
- BA   to   Fn2   Fn3

From this starting point, the following steps were used to map all tasks and sub-tasks:

- Identify all tasks that are common between the Joint and FORCEnet concepts.

- Identify all additional Joint tasks (sub-tasks) that should be included in FORCEnet.

- Using the complete FORCEnet task and sub-task set, determine the assignments to FORCEnet capabilities. (As noted above, the initial mapping cannot be used for all assignments. Table 4 shows the results of this "mix-and-match" process.)
  - o Perform the logical segmenting of Fn5 into Fn5-Cognitive and Fn5-Informational; also Fn11 into Fn11-Informational and Fn11-Organizational.

  - o Transfer some NCE Knowledge Area tasks to Basic C2 by assigning them to Fn7.

  - o Transfer some JC2 Collaborative tasks to NCE by assigning them to Fn1.

  - o Transfer some BA Enabling tasks to NCE by assigning them to Fn1 and Fn14.

A summary of this complicated set of steps to accomplish adequate mapping is shown in Table 4 and the full results in Appendix A. Appendix A shows all FORCEnet and Joint tasks and sub-tasks and the mapping at the sub-task level.

4.5 FORCEnet Tasks, Sub-Tasks, and Sources

Table 4 contains FORCEnet tasks and sub-tasks for all capabilities and identifies their sources. This is not the set that appears in the Annex. The Annex set was derived from this one, with some additions and deletions, as appropriate. For example, the task "execute collection" is appropriate for BA but not for FORCEnet. The fact that this is not the final task list is of no consequence because the purpose of this report is to present the mapping process rather than a final result.

Fn15 is not included in Table 4. It is not included in this report because it is an overarching capability, essentially the sum-total of what FORCEnet enables. Also, in the Annex some of the purely operational tasks have been transferred from where they appear here to Fn15.

Table 4. FORCEnet Capabilities Task and Sub-Task List

Source	Task / Sub-Task	Source	Task / Sub-Task
	Fn1		**Fn2**
NCE	Connect with all assets	Fn2	Report Blue ID, location, status...
NCE	Support Role-Based Access Control	Fn2	Report own status
NCE	Support Strong Authentication	Fn2	ID, calc, non-report friendly units
NCE	Rapidly Deploy/Employ Robust Connectivity Fwd	Fn2	ID for any node where other is
NCE	Function Under Range of Infrastructure and ROE	Fn2	Report Blue intent
NCE	Dynamically Plan Net Arch Develop Process	Fn2	Project Blue movement
NCE	Operate Without Geographical Constraints	Fn2	Report Blue FP posture
NCE	Operate Without Geographical Constraints	Fn2	Project Engagements
BA	Comprehensively Connect the Force	Fn2	Project Blue/Red Engagement
NCE	Support Geographically Transitioning Nodes	Fn2	Project Friendly/Red Engagement
NCE	ID & Awareness all Nodes All Time		
BA	Rapidly Deploy BA network		**Fn3**
Fn1	Publish services availability	BA	Gain access (Physical to airspace)
Fn1	Publish & subscribe to info	BA	Employ human resources
NCE	Tailor to Specific Capabilities	BA	Employ open source resources
NCE	Provide Timely and Reliable Delivery of Infor	BA	Measure & monitor environmental conditions
NCE	Easily Search, File, Xfer, Com., Support Net	BA	Assess collection performance
Fn1	Provide redundant comms channels	BA	Develop collection plan
Fn1	Ensure net availability & reliability	BA	Provide continuous surveillance
NCE	Manage Continuity and Restoration of Ops	BA	Surveil broad areas synoptically
NCE	Detect and Defend Against logical Attack	BA	Focus/stare on targets of interest
NCE	Dynamically Re-Route Services	BA	Find, identify, and track
NCE	Degrade Gracefully, Contain Cascade Failures	Fn3	Provide combat assessment
NCE	Continue Essential Operations in Degraded Env	BA	Synchronize ISR with operations
BA	Utilize Secure and Robust Communications	BA	Task and dynamically re-task assets
Fn1	Provide sufficient QoS all nodes	BA	Monitor/track assets & their activities
	Fn4		**Fn5C**
Fn4	Establish Information Environment	Fn5C	Analyze Information
NCE	Establish Criteria for Storing and Sharing	Fn5C	Evaluate Information

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NCE	Share Access Across Areas
NCE	Support Enterprise-Wide and COI-Specific Appl
NCE	Support Dynamic, Priority-Based Resource Alloc
NCE	Share Stored Information
Fn4	Establish metadata registries
Fn4	Establish data/metadata standards
NCE	Consume Information
NCE	Enable Machine-to-Machine Information sharing
NCE	Train Using Simulation and Mission Rehersal
NCE	Discover/Search
NCE	Pull/Retrieve/Access
NCE	Perform Intelligent Search/Smart Pull
Fn4	Advertise information
NCE	Message
NCE	Display Information
NCE	Subscribe
NCE	Support Multi-Level Security
NCE	Share Across Security Areas (Coalition, HLS)
Fn4	Ensure storage redundancy
Fn4	Retrieve information
Fn4	Provide info compliant with standards

Fn5C	Synthesize Information
Fn5C	De-conflict multiple reports
BA	Recognize targets
BA	Information fusion
Fn5C	Utilize Simulation for analysis
BA	Auto-populate models & simulations
BA	ID enemy courses of action
BA	Integrate adversary & friendly information
BA	Include cultures, social issues, & resources
BA	Conduct Distributed analysis
BA	Enable analyst collaboration
BA	Conduct distributed archive
BA	Collaborate between analytic centers
BA	ID Red patterns of behavior
BA	Defeat denial & deception
BA	Produce Assessments
Fn5C	Distribute Battlespace knowledge
BA	Smart push/pull information
BA	Share plan visibility
BA	Maintain an open archive
BA	Allow for quality BA information flow
BA	Allow for timely BA information flow
BA	Allow for secure BA information flow
BA	Allow for ubiquitous BA information flow

Fn5I

NCE	Transform/Process Data Into Info
NCE	Collect Data
NCE	Process Information
NCE	Support Mediation/Translation Services
NCE	Correlate and Fuse Information
Fn5I	Sort Information
NCE	Link Geographic Info to Underlying Database
NCE	Provide Layering and Drill-Down
Fn5I	Correlate reports over time
NCE	Simulate Process Multiple Source Inputs
Fn5I	Catalog Information
Fn5I	Archive
NCE	Tag Information
NCE	Archive

Fn6

JC2	Develop an Operational Net Assess
Fn6	Correlate information elements
Fn6	Access & manage info repository
JC2	Update info products real time
JC2	Provide Current and Accurate Data
JC2	Achieve a COP
Fn6	Present Blue/Red/Grey Situation info
Fn6	Represent info visually
Fn6	Represent info aurally
Fn6	Create user-defined representations
Fn6	Share user-defined visualizations
JC2	Identify and Track Blue/Red/Gray Forces
JC2	Develop "Observables" for Assessment
JC2	Provide Feedback on Operations
Fn6	Represent info temporally
JC2	Assess Countermeasures

Fn7

JC2	Develop common situation understanding
Fn7	Share plans & info products
Fn7	Collaboratively create alterable work products
Fn7	Integrate/sync inputs, modes, media

Fn8

Fn8	User specified search for info
Fn8	Provide automated simulations
Fn8	Provide targeting solutions
Fn8	User-defined threshold alerts

JC2	Achieve Global Situational Awareness
JC2	Develop Situational Awareness
JC2	Assess Changes in Adversary's Systems
NC	Achieve Shared Awareness
JC2	Improve Shared Understanding
JC2	Maintain Shared Understanding
NCE	Achieve Situational Awareness
NCE	Use Multiple Methods to Achieve SU
NCE	Achieve Higher Quality SU via Multiple Means
JC2	Discern and Follow Commander's Intent
JC2	Collaborate on Commander's Intent
NCE	Communicate Understand to Other decision makers
NCE	Communicate SA to Other Decision-makers
JC2	Be Networked (organizationally)
JC2	Employ Network Centric Methods
JC2	Link the Force in Time and Purpose
JC2	Conduct Simultaneous C2 Functions
JC2	Develop and Sustain Unity of Command
JC2	Provide Leadership
JC2	Empower Lower Echelons
JC2	Command Throughout Echelons
JC2	Develop, Maintain Adaptive Command Processes
JC2	Dev Plan Based on Miss Anal & Cdr Intent
JC2	Assess Decisions
JC2	Develop a Plan Including Pre/Post Conflict Effects
JC2	Precisely Derive Adversary Courses of Action
JC2	Select a CoA Based on Capabilities Assessment
Fn7	Integrate diverse miss planning
JC2	Provide a Collaborative Environment
Fn7	Form distributed teams, CoIs
JC2	Provide the Means to Act on Provided Information
NCE	Overcome Organization/Cultural Limits to Collaboration
NCE	Establish Trust in Decision-making Collaboration
JC2	Conduct Effects-Based Operations
JC2	Achieve Desired Effects
JC2	Re-focus Decisions Based On Adversary Actions
JC2	Collaboratively Plan
JC2	Interact with Interagency & Foreign Entities
JC2	Employ Discourse with Subordinates
JC2	Employ a Globally Deployed Collab Plan Environ
JC2	Orchestrate in a Collaborative Planning Environ
NCE	Make High Quality Decisions

Fn8	Recognize patterns
Fn8	Suggest changes to user preferences
Fn8	Make info patterns assertions
JC2	Project movement, trends, outcomes
Fn8	Aggregate data into larger groups
Fn8	Generate auto-routing, navigation solutions

Fn9

Fn9	Authenticate all info and sources
Fn9	Protect all information
BA	Protect Sensors Information & Info Networks
NCE	Assure Information
NCE	Validate Information
NCE	Determine an Information Pedigree
Fn9	ID info disruption, denial, destruction
Fn9	ID system disruption, denial, destruction
NCE	Develop Trust in the Information
NCE	Restore/Recover
NCE	Assure Information

Fn10

Fn10	ID clearance of network nodes
Fn10	Track classification all info
Fn10	Correlate clearance with classification
Fn10	Control access to information
Fn10	Sanitize or downgrade as appropriate

Fn11-O

Fn11	Incorporate non-DoD into JC2
JC2	Be Adaptable
JC2	Employ the Appropriate Joint Capabilities
JC2	Apply Coalition Resources
JC2	Employ Combined Forces
JC2	Apply Interagency Resources
JC2	Synchronize
JC2	Self-Synchronize
JC2	Be Expeditionary
JC2	Be Decentralized
JC2	Be Adaptable
JC2	Conduct Joint Fires
JC2	Access Data from All Relevant Sources
JC2	Share Collected Information
JC2	Access Horizontally & Vertically Integrated Info
JC2	Interact on Fully Integrate System Global Comms

Fn11-I

Fn11	Establish C2 Systems Standards
Fn11	Comply with C2 Systems Standards

Fn12

Fn12	Optimize communications with limited throughput
NCE	Know Tasks and Teams Assigned to Tasks

NCE	Access Immediate Data	NCE	Interact Effectively with DSTs in a Collab Environ
NCE	Have Timely, Relevant, Decision-making Info	NCE	Interact/Accept Inputs from Non-Traditional CoIs
Fn11	Translate system, formats, protocols	Fn12	Prioritize info requirements
Fn11	Provide system interface services	Fn12	Interpolate/extrapolate patterns
		NCE	Know Available Assets Enterprise-Wide
		Fn12	Provide recent location info

Fn13		**Fn14**	
Fn13	Monitor system usage & performance	Fn14	Incorporate new technologies
Fn13	Allocate/reallocate C2 resources	NCE	Flexibly Adapt to Changing Operational Needs
NCE	Wargame the Network	NCE	Deal with Flexible Authority Relations
Fn13	Manage network accounts	NCE	Maintain Flexible Attitudes to Power & Authority
NCE	Support Ops and Transit States Along ROMO	Fn14	Adopt new doctrine & TTP
NCE	Manage Assured Access/Denial	BA	Rapid restructuring of BA structure
Fn13	Provide/manage network services	NCE	Flexibly Adapt Act to Take Adv of Opportunities.
NCE	Prioritize Data Flows from Databases/Backups	NCE	Flexibly Adapt Act to Min Impact of Threats
NCE	Acquire Additional Network Resources on Demand	Fn14	Create new organizations
Fn13	ID need to intervene in C2 systems		
NCE	Inform/Update Chain-of-Command Net Status		

5.0 ASSIGNING ATTRIBUTES

5.1   Attribute Groups

Attributes are often assigned to tasks a-priori as a means to more fully describe the tasks. This provides a means for describing those aspects of tasks that are important for the operations they support. In order to keep these assignments from becoming too voluminous, we make assignments only at the task level, not at the sub-task level. Assignments at the sub-task level are done when a specific project is being undertaken, such as an experiment.

It is not useful for a-priori attribute assignments to utilize all of the 100-plus attributes. The nuances represented by the full set are needed only when specific measures are to be defined, such as for an experiment. Simplification is accomplished by assigning similar/related attributes to groups. Thirteen groups are created in this way and they are shown in Table 5. The titles of these groups are used for the a-priori assignments, reducing the number of possible assignments from 100 to 13.

Table 5. Attribute Groups

Accessible	Assured	Capable	Compatible
Accessible	Accurate	Capable	Collaborative
Automatic	Assured	Competent	Compatible
Integrated	Authentic	Confident	Congruent
Networked	Compliant	Cooperative	Connected
Ordered	Consistent	Engaged	Coordinated
	Correct	Experienced	Correlated
	Non-Repudiated	Learning	Interdependent
	Persistent	Trusted	Interoperable
	Precise	Trusting	Sharable
	Secure	Willing	
	Traceable		
	Uncompromised		

Effective	Extensive	Flexible	Manageable
Effective	Capacity	Adaptable	Controllable
Efficient	Distributed	Flexible	Deployable
Enhanced	Diverse	Innovative	Manageable
Lethal	Extensive	Permissive	Maneuverable
Relevant	Pervasive	Responsive	Sortable
Self-Organizing	Range	Risk Accepting	Transportable
Size	Reach	Scalable	
Superior		Tailorable	
Value Added		Upgradeable	

Robust	**Structured**	**Sufficient**	**Timely**
Autonomous	Layered	Complete	Continuous
Duplicative	Modular	Sufficient	Current
Graceful Degradation	Open System		Frequent
Maintainable	Standard		Synchronized
Redundant	Structured		Timely
Repairable			
Robust			
Self-Healing			
Survivable			

Usable
Clear
Intuitive
Seamless
Unambiguous
Usable
User Defined
User Friendly
Visual

5.2   FORCEnet Attribute Assignments

Attributes have been assigned to each of the tasks associated with the FORCEnet capabilities. These assignments are shown in Table 6. The dark cells show the assignments.

Table 6. FORCEnet Attribute to Task Assignments

		Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
Fn1														
1.1	Connect with all assets	X			X		X							
1.2	ID & Awareness all Nodes All Time	X							X		X			
1.3	Rapidly Deploy BA network	X					X						X	
1.4	Publish services availability	X							X			X		
1.5	Publish & subscribe to info	X			X									X
1.6	Provide redundant communications channels	X								X				
1.7	Ensure net availability & reliability	X			X				X					
1.8	Provide sufficient Quality of Service to all nodes	X										X		
Fn2														
2.1	Report Blue ID, location, status...		X										X	
2.2	Report Blue intent		X											
2.3	Project Blue movement		X											
2.4	Report Blue FP posture		X											
2.5	Project Engagements		X											
Fn3														
3.1	Gain access (Physical to airspace)												X	
3.2	Employ human resources			X										
3.3	Employ open source resources					X			X					
3.4	Measure & monitor environmental conditions		X										X	
3.5	Assess collection performance		X										X	
3.6	Develop collection plan		X											
3.7	Provide continuous surveillance								X					
3.8	Provide combat assessment		X											
3.9	Synchronize ISR with operations				X				X			X		
3.10	Task and dynamically re-task assets		X						X					
3.11	Monitor/track assets & their activities		X						X					
Fn4														
4.1	Establish Information Environment	X			X				X		X			X
4.2	Share Stored Information	X			X				X					
4.3	Establish metadata registries										X			
4.4	Consume Information	X												X
4.5	Advertise information										X			
4.6	Subscribe	X												X
4.7	Ensure storage redundancy									X			X	
4.8	Retrieve information	X											X	
4.9	Provide info compliant with standards		X								X			

		Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
	Fn5C													
5.1	Analyze Information		■					■			■	■		
5.2	Utilize Simulation for analysis					■								
5.3	Conduct Distributed analysis	■			■		■						■	
5.4	ID Red patterns of behavior		■											
5.5	Defeat denial & deception					■				■		■		
5.6	Produce Assessments		■					■			■			
5.7	Distribute Battlespace knowledge	■					■					■		
	Fn5I													
5.8	Transform/Process Data Into Info		■			■								
5.9	Support Mediation/Translation Services			■							■			
5.10	Sort Information		■							■				
5.12	Correlate reports over time		■								■			
5.13	Simulate Process Multiple Source Inputs							■						
5.14	Catalog Information													■
5.15	Archive		■								■			
6.1	**Fn6**													
6.2	Develop an Operational Net Assess		■			■						■	■	
6.3	Achieve a COP	■			■					■		■	■	
6.4	Represent info temporally												■	
6.5	Assess Countermeasures		■											
	Fn7													
7.1	Develop common situation understanding		■			■						■		
7.2	Discern and Follow Commander's Intent	■												
7.3	Communicate Understand to Other decision makers					■						■		
7.4	Be Networked (organizationally)	■		■										
7.5	Develop and Sustain Unity of Command					■			■					
7.6	Dev Plan Based on Miss Anal & Cdr Intent		■					■				■	■	
7.7	Integrate diverse mission planning	■	■					■						
7.8	Provide a Collaborative Environment	■				■	■		■		■			
7.9	Conduct Effects-Based Operations		■			■						■		
7.10	Collaboratively Plan		■			■								
7.11	Make High Quality Decisions		■										■	
	Fn8													
8.1	User specified search for info							■			■			
8.2	Provide automated simulations		■			■							■	
8.3	Provide targeting solutions												■	
8.4	User-defined threshold alerts							■			■			
8.5	Recognize patterns			■										
8.6	Suggest changes to user preferences			■									■	
8.7	Make info patterns assertions		■										■	
8.8	Project movement, trends, outcomes		■					■			■			
8.9	Aggregate data into larger groups							■			■			
8.10	Generate auto-routing, navigation solutions		■			■							■	

#		Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
	Fn9													
9.1	Authenticate all info and sources		X											
9.2	Protect all information									X				
9.3	Assure Information		X											
9.4	ID info disruption, denial, destruction									X				
9.5	ID system disruption, denial, destruction									X				
9.6	Develop Trust in the Information		X											
9.7	Restore/Recover								X				X	
	Fn10													
10.1	ID clearance of network nodes					X			X					
10.2	Track classification all info													
10.3	Correlate clearance with classification				X									
10.4	Control access to information				X	X								
10.5	Sanitize or downgrade as appropriate								X					
	Fn11I													
11.1	Establish C2 Systems Standards										X			
11.2	Comply with C2 Systems Standards										X			
11.3	Access Immediate Data	X												X
11.4	Translate system, formats, protocols								X					
11.5	Provide system interface services				X	X			X					
11.6	**Fn11O**													
11.7	Incorporate non-DoD into JC2	X						X						
11.8	Synchronize				X				X				X	
11.9	Be Expeditionary													
11.10	Conduct Joint Fires	X			X								X	
11.12	Access Data from All Relevant Sources	X												
11.13	Share Collected Information				X									
11.14	Interact on Fully Integrated System Global Coms							X						
	Fn12													
12.1	Optimize coms with limited throughput	X				X						X		X
12.2	Know Tasks and Teams Assigned to Tasks			X							X			
12.3	Interact Effectively with DSTs in a Collab Environ					X		X						
12.4	Interact/Accept Inputs from Non-Traditional CoIs			X										
12.5	Prioritize info requirements		X					X			X			
12.6	Interpolate/extrapolate patterns													
12.7	Know Available Assets Enterprise-Wide													

		Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
Fn13														
13.1	Monitor system usage & performance	■					■		■					
13.2	Allocate/reallocate C2 resources				■			■						
13.3	Wargame the Network							■						
13.4	Manage network accounts	■						■						
13.5	Provide/manage network services				■		■	■						
13.6	Acquire Additional Network Resources on Demand	■						■	■					
13.7	ID need to intervene in C2 systems			■					■					
13.8	Inform/Update Chain-of-Command on Network Status		■						■				■	
Fn14														
14.1	Incorporate new technologies							■						■
14.2	Flexibly Adapt to Changing Operational Needs							■					■	
14.3	Adopt new doctrine & TTP				■			■						
14.4	Rapid restructuring of BA structure							■					■	
14.5	Flexibly Adapt Act to Take Adv of Opportunities							■						
14.6	Flexibly Adapt Act to Min Impact of Threats							■						
14.7	Create new organizations			■		■		■						

6.0 MEASURES

There is a substantial body of literature that deals with measures/metrics. There is a fair amount of semantic and conceptual diversity in this literature. In this report we take a simple and straightforward approach, concentrating on measures that support production of results through experimentation. That approach is described in this section. The next section will describe how the approach is applied to reporting experiment results.

We have based our work on material found in the "Command and Control Effectiveness Handbook", published by the US Army TRADOC Research and Analysis Center. This handbook is based on the "Modular Command and Control Evaluation Structure (MCES)" produced by a series of workshops sponsored by the Military Operational Research Society. The following figure is from the MCES document.
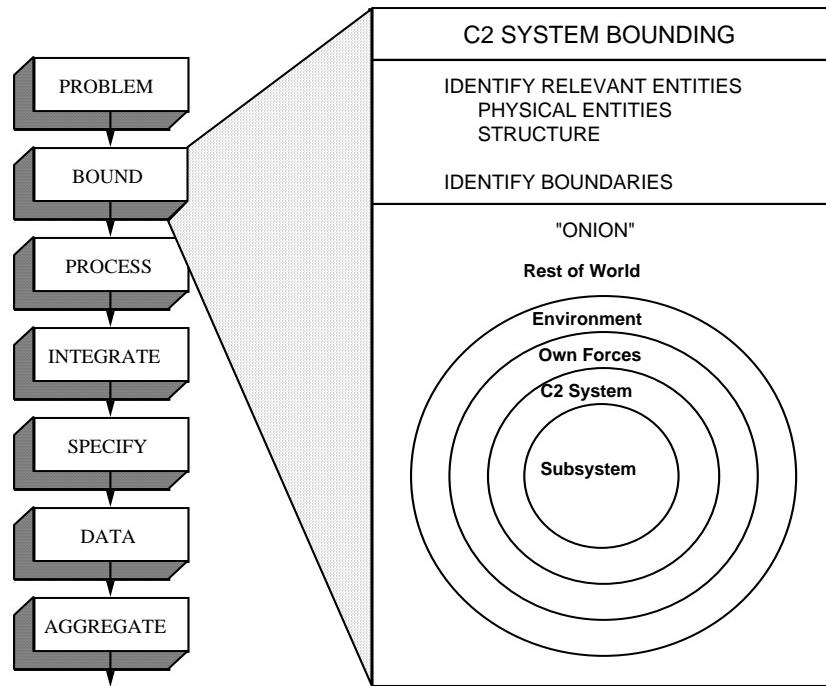
Figure 2. MCES C2 System Bounding

Figure 2 provides a useful perspective with respect to measures. Measures can be defined for any of the levels shown in the "Onion Skin" diagram. Until one specifies the problem, and the bounds associated with the problem, it is not possible to identify measures as being Measures of Effectiveness (MOE) or Measures of Performance (MOP). What one considers an MOE or MOP depends on where the boundaries are drawn. This is described in sub-section 6.1.

6.1 Use of MOPs and MOEs

Whether a particular measure is called an MOE or an MOP is context dependent, so doing a-priori assignments can be misleading. In this report we present no MOPs or MOEs for the 15 FORCEnet Capabilities or their tasks. The following discussion illustrates the situation.

Assume an experiment is to be conducted with the purpose of developing or testing mission planning capabilities. Assume there is a specific Objective for the mission planning capability, and three Goals for that Objective. It is natural to have an MOE associated with the capability.

	MOE	MOP
Capability: Mission Planning	Planning Quality	Tool-set Quality

The experiment objective could be to develop a planning tool-set. There will be a natural MOE associated with the effectiveness of the set.

	MOE	MOP
Objective: Develop planning tools.	Tool-set Quality	Tools Quality

Lower-level objectives could be to develop/test three tools in the tool-set, with goals that each have specific attributes.

	Attribute		MOP	Measures
Goal 1 – Provide	**rapid**	reach-back	Timeliness	Not Specified
Goal 2 – Provide	**complete**	information	Completeness	"
Goal 3 – Provide	**consistent**	COP	Consistency	"

FORCEnet Attributes associated with the Goals are shown in bold. The three MOPs listed for the Goals are not complete because actual measures aren't specified. The problem can be bounded at any of the levels shown above.

The example shows that the MOP and MOE specifications are not definite. With the three measures associated with the Goals as MOPs, a specified measure for quality of the planning tool-set would be an MOE and it would be an aggregate of the MOPs. However, it is also possible, and correct, to have tool-set quality be an MOP, along with other like-level MOPs, under the mission planning MOE. Thus, tool-set quality can be either an MOP or MOE.

At the lower end, one can also introduce other levels, such as breaking down reach-back into component MOPs associated with the reach-back systems and processes, resulting in reach-back timeliness being an MOE.

Using only the term measures, as is done in this report, is preferable to attempting to define a-priori MOPs and MOEs. What one calls effectiveness and performance depends on how one wishes to express results, that is, where one wishes to place the effectiveness-performance boundary.

6.2   Objective and Subjective Measures, Quantification, Rollups

For systems testing one most often utilizes objective measures. Direct quantitative measurements are made of parameters such as bandwidth, processing times, capacity. Measures that address operational capabilities are often subjective.   It is appropriate to refer to information gathered during the course of investigations as data regardless of whether it is subjective or objective.

A type of data on the boundary of objective and subjective is event-capture by observers. The observer notes events that occur at a specific time, providing time-marked data. The event can be an occurrence that is definite, such as information appearing on the COP, which clearly falls in the objective category. An observation can be less definite such as noting the time at which an operator becomes overloaded, possibly lowering his efficiency. That observation is somewhat subjective because whether or not the operator is overloaded may be a matter of opinion.

Subjective measures are most often the opinions of subject-matter-experts, including operators who are performing tasks during the time needed data is to be captured. Their opinion is sought about whether or not a process is effective, whether information is useful, whether a particular system makes a process more efficient, etc. How much weight one places on purely subjective data depends on the observer's level of expertise and experiment parameters such as how representative were the conditions under which the expert was performing the task.

As was noted earlier in this report, measures are the quantification of attributes. This means that measures need to be quantified in order to most useful. Objective data is automatically quantified. Subjective data is most often quantified by obtaining several pieces and performing some sort of processing, such as averaging, or by having the data provided on a specified scale. Discussing the accuracy of quantification techniques is beyond the scope of this report.

The examples in sub-section 6.1 provide illustrations of the above measures discussions:

- Timeliness for rapid reach-back is objective presuming that time stamps are provided for request and receipt.

- Information completeness can be either objective if a count is made of numbers required and provided or subjective if an opinion is obtained as to whether all the information is available to get the task done.

- Rollups: Tool-set quality can also be either subjective or objective. In order to provide an objective, or any type of quantitative, tool-set quality measure, a means is need to combine the individual tool quality measures. This is essentially a rollup from MOPs to an MOE.

Rollups to higher-level measures are often difficult to define in a way that provides an adequate determination of the higher-level attribute. It is an art that is beyond the scope of this report.

6.3 Example Measures

A table containing example measures for all FORCEnet tasks, for each of their attributes, is presented in Appendix B.

These measures are not meant to answer every need for quantification, but are examples of the types of measures that could be used. As has been noted, actual measures will depend on the situation being addressed.

7.0. REPORTING EXPERIMENT RESULTS

7.1 FORCEnet Experiment Structure

FORCEnet experiments involve networks, information, the decision processes they support, and the humans making the decisions. The following figure illustrates this system.
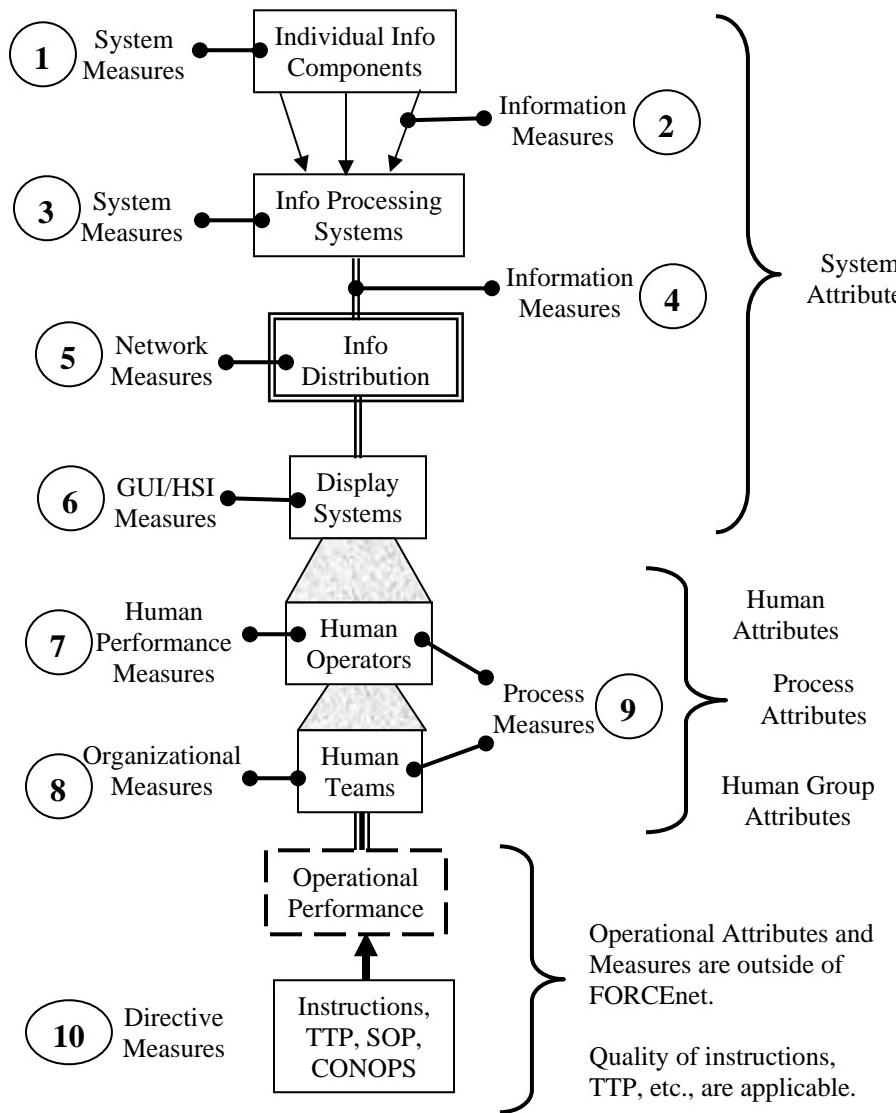
Figure 3. FORCEnet Experiment Components, Attributes, and Measures.

These are the components that are involved in task performance. Components included are systems, the processes/tasks that are performed by humans and teams, and the various directives that guide task performance and decision-making.

It is useful to group attributes and measures into types when planning experimentation and/or studies. Type categories are not absolute, but useful sets for FORCEnet experimentation are:

Attribute types:
- System
- Process
- Human
- Human Group

Measure types:
- System
- Network
- Human-System Interaction
- Human
- Organizational
- Directive

These attribute and measure types and their relations to FORCEnet components are shown in the figure, with the measure types numbered.

Human operators can be part of any system or process node. When they are part of a system, measures can be obtained for both human-system interaction and human performance. When they are participating in a process, measures can be obtained for both process quality and human performance.

Specific measures to be used are highly dependent on the situation. The steps one takes in developing measures, e.g. for an experiment, are:

1. Decide which FORCEnet component will be examined.

2. Decide which specific system or process will be examined.

3. Decide what aspect of the component will be examined, that is, which attribute.

4. Develop the specific question to be asked or the examination goal.

5. Specify the measure(s) to be determined to address the question/goal.

6. Assure that the attribute, question, and measure(s) are congruent.

Example measures are presented in Appendix 2. .

7.2 Experiment Planning, Mapping to FORCEnet Capabilities

During experiment planning the structure is set up that enables reporting results to the appropriate capabilities and tasks. For FORCEnet experiments, the initial phases of planning proceed as shown in Figure 4.
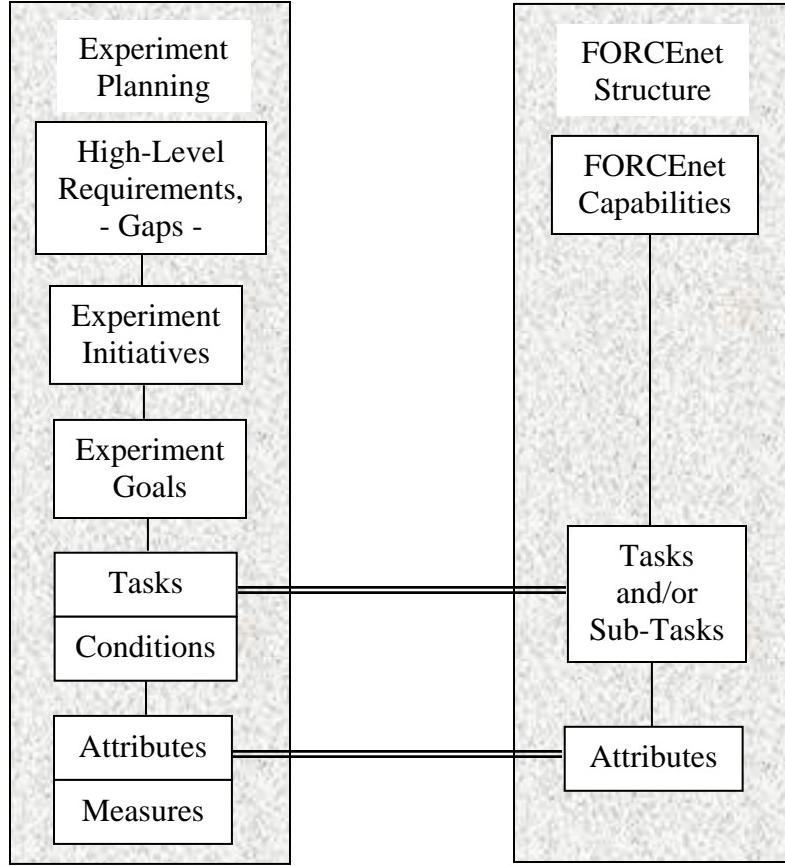
Figure 4. Matching Experiment to FORCEnet Structure

Experiment planning proceeds from high-level requirements. The overarching objective is often to develop C2 systems and processes that will fill capabilities gaps. It is not normally the case that the initiatives and goals are designed to produce FORCEnet capabilities.

During the planning process, specific goals are developed. These goals are related to specific operational tasks and conditions under which those tasks are to be performed. It is always the case that attributes and measures are associated with determining whether goals have been achieved.

> *Mapping of experiment to FORCEnet capabilities is done*
> *utilizing the task-to-task and attribute-to-attribute correlations.*

Mapping experiment results to report their contribution to FORCEnet capabilities is easily done using the above stricture. Results are expressed as the measures that have been determined. These measures are attribute quantifications. The tasks and values for the attributes are directly related FORCEnet tasks and attributes. Figure 4 illustrates the process,

```
┌──────────────┐
│ Experiment   │
│ Results      │                      ┌──────────────┐
├──────────────┤      ┌──────────┐    │ Matching     │
│ Measures     │══════│Attributes│════│ Attribute    │
└──────────────┘      └──────────┘    └──────────────┘
                           │                  │
                           ▼                  │
                     ┌──────────┐    ┌──────────────┐
                     │ Task     │    │ Same or      │
                     │Performance│═══│ Related Task │
                     └──────────┘    └──────────────┘
                                            │
                                            ▼
                                     ┌──────────────┐
                                     │ FORCEnet     │
                                     │ Capability   │
                                     │ Contribution │
                                     └──────────────┘
```
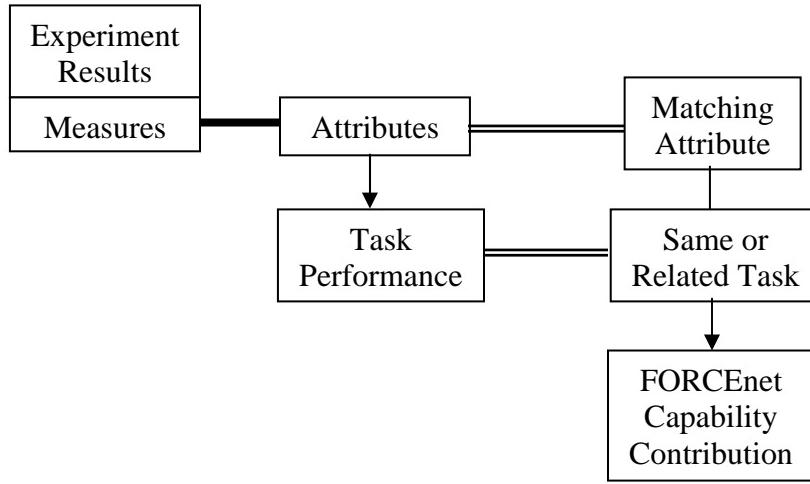
Figure 5. Translating Results to FORCEnet Capabilities

7.3 Utilizing the Full Attribute Set

It may be the case that, in the course of experiment planning, the 13 attribute that specify the attribute groups are not sufficiently precise to be used for some of the goals. When this is the case, the planner will utilize an attribute within a group. Mapping from this attribute to FORCEnet is easily done through the group attribute, which is what is used in the FORCEnet structure.

7.4 Mapping Results to Other Venues

Mapping results to other venues requires that they first be mapped to FORCEnet capabilities and tasks, then the mapping from FORCEnet to the other venue is utilized. Figure 6 illustrates the process.

```
                      FORCEnet              Other
                                            Venue
                  ┌──────────┐          ┌──────────┐
                  │  Tasks   │══════════│  Tasks   │
                  ├──────────┤Correlations├────────┤
   ┌──────────┐   │Attributes│══════════│Attributes│
   │ Results  │──▶│          │          │          │
   ├──────────┤   └──────────┘          └──────────┘
   │ Context  │                              ▲
   └──────────┘                              │
        └────────────── If Correlated ───────┘
```
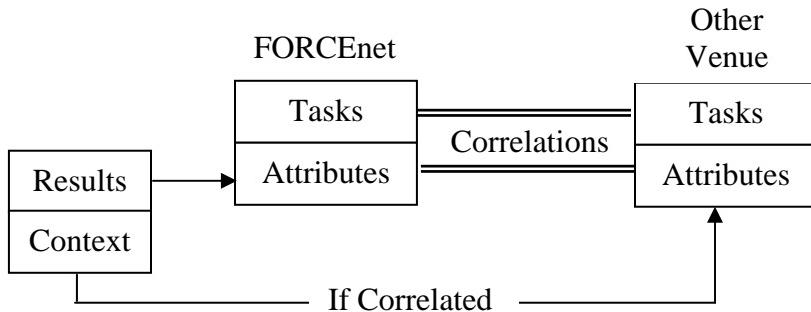
Figure 6. Translating Results to Other Venues.
```

There is no guarantee that the tasks/processes used in the experiment will be exactly the same as stated in the other venue (or even exactly the same as FORCEnet capability tasks). This is why we use the term "translating" in the title of Figure 6. Whether or not some modification of the results is needed depends on how closely related the tasks are. If they are not fairly close, it will not be possible to translate the results.

Context is important and must be carried forward with the result. It may be that the result is only valid for particular situations, using particular systems, or while utilizing particular processes. These types of context are part of the result.

## 7.5  Reporting and Results Pedigree

It is often the case that it is difficult to determine results pedigrees once they are reported at levels higher than the experiment itself. The schema reported here for mapping results to structures other than that of the experiment's makes it possible to do so.

The schema in this report is being implemented in the Naval Postgraduate School's knowledge management system, FORCEnet Innovation and Research Enterprise, FIRE. All of the links shown in Figures 3 and 4 are being implemented in the system. This will make it possible to drill down from a result at any level to the supporting data, and also obtain the conditions under which the data were acquired.

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**Appendix A.  Sub-Task Level Mapping**

This appendix contains the spreadsheets that show the methods used to map Joint Functional Concept tasks and sub-tasks to FORCEnet capabilities and the mapping results.  The spreadsheets contain a large amount of diverse information and the following explanations are a guide to understanding the structure.

The spreadsheets are large so they are presented in sections.  Lines in the sheets are used to segment sections and to make it easier to trace rows and columns.  Most task and sub-task names are abbreviated.

As was stated in the bulk of this report, the basic mapping from Joint Functional Concepts (JFCs) to FORCEnet capabilities is as follows:

| | | |
|---|---|---|
| Battlespace Awareness | to | FORCEnet Capabilities 2, 3, and 5-C |
| Joint Command & Control | to | FORCEnet Capabilities 6, 7, 8, and 11-O |
| Net-Centric Environment | to | FORCEnet Capabilities 1, 4, 5-I, 9, 10, 11-I, 12-14 |

The spreadsheet rows and columns are:

- JFC capabilities, tasks, and sub-tasks are in the rows at the left.

- The domain of each task and sub-task is in the column following the task name.

- FORCEnet capability numbers and short titles head a set of columns that contain their tasks and sub-tasks.

- Whether a particular column is a task (T) or sub-task (S) is indicated below the title.

- The domains of FORCEnet tasks and sub-tasks are indicated below the title.

Which are FORCEnet tasks and sub-tasks is indicated as noted above.  Their placement indicates which sub-tasks belong to which tasks:

- A sub-task is shown immediately to the right of the task to which it belongs.

The interiors of the spreadsheets show associations between Joint Functional Concepts and FORCEnet and also show task to sub-task associations.

- "T" in a cell indicates that the Joint and FORCEnet tasks are essentially the same.

- "S" in a cell indicates that the Joint sub-task listed is a sub-task of the FORCEnet task heading the column.

The result of this spreadsheet structure is that complete set of FORCEnet tasks and sub-tasks are shown by:

- All FORCEnet tasks are shown at the top of the sheet and indicated by the "T" below them.

- All FORCEnet sub-tasks are shown by:
  - at the top of the sheet with an "S" and placed to the right of the task to which it belongs,
  - within the sheet with an "S" in the cell and placed below the task to which it belongs.

**Table A. JCIDS to FORCEnet Sub-Task Level Mapping**

| Tasks Map for BA to Fn2, 3, 5-C — Levels: P = Physical, I = Informational, C = Cognitive, O = Organizational | Level | Report Blue ID, location, status... | Report own status | ID, calc, non-report friendlies | ID for any node where other is | Report Blue intent | Project Blue movement | Report Blue FP posture | Project Engagements | Project Blue/Red Engagement | Project Friendly/Red Engagement | Gain access (Physical to airspace) | Employ human resources | Employ open source resources | Measure & monitor environm cond | Assess collection performance | Develop collection plan | Provide continuous surveillance | Provide combat assessment | Synchronize ISR with operations | Task and dynamically re-task assets | Monitor/track assets & their activities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domain ---> | | I | I | I | I | C | I | I | C | C | C | P | I | I | I | C | C | I | C | C | C | C |
| Task (T) or Subtask (S) ---> | | T | S | S | S | T | T | T | T | S | S | T | T | T | T | T | T | T | T | T | T | T |
| **BA Operational Capabilities** | | | | | | | | | | | | | | | | | | | | | | |
| **Command and Control of BA Assets** | | | | | | | | | | | | | | | | | | | | | | |
| Synchronize ISR with operations | O | | | | | | | | | | | | | | | | | | | T | | |
| Task and dynamically re-task assets | C | | | | | | | | | | | | | | | | | | | | T | |
| Monitor/track assets & their activities | I | | | | | | | | | | | | | | | | | | | | | T |
| Plan | O | | | | | | | | | | | | | | | | T | | | | | |
| Assess | C | | | | | | | | | | | | | | | T | | | | | | |
| **Execute Collection** | | | | | | | | | | | | | | | | | | | | | | |
| Gain access (Physical to airspace) | P | | | | | | | | | | | T | | | | | | | | | | |
| Surveil broad areas synoptically | I | | | | | | | | | | | | | | | | | S | | | | |
| Focus/stare on targets of interest | I | | | | | | | | | | | | | | | | | S | | | | |
| Find, identify, and track | I | | | | | | | | | | | | | | | | | S | | | | |
| Employ human resources | I | | | | | | | | | | | | T | | | | | | | | | |
| Employ open source resources | I | | | | | | | | | | | | | T | | | | | | | | |
| Measure & monitor environmental conditions | I | | | | | | | | | | | | | | T | | | | | | | |
| **Exploitation and Analysis** | | | | | | | | | | | | | | | | | | | | | | |
| Recognize targets | C | | | | | | | | | | | | | | | | | | | | | |
| Distribute processing | I | | | | | | | | | | | | | | | | | | | | | |
| Information fusion | C | | | | | | | | | | | | | | | | | | | | | |
| Enable analyst collaboration | C | | | | | | | | | | | | | | | | | | | | | |
| Conduct distributed archive | I | | | | | | | | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| Collaborate between analytic centers | **O** | | |
| ID Red patterns of behavior | **C** | | |
| Defeat denial & deception | **C** | | |
| **Model, Simulate and Forecast** | | | |
| Auto-populate models & simulations | **I** | | |
| ID enemy courses of action | **C** | | |
| Integrate adversary & friendly information | **I** | | |
| Include cultures, social issues, & resources | **C** | | |
| **Manage Knowledge** | | | |
| Smart push/pull information | **I** | | |
| Share plan visibility | **I** | | |
| Allow producer interactions | **I** | | |
| Maintain an open archive | **I/P** | | |
| **Battlespace Awareness Enabling Capabilities** | | | |
| **Integrate BA Network** | | | |
| Allow for quality BA information flow | **I** | | |
| Allow for timely BA information flow | **I** | | |
| Allow for secure BA information flow | **I** | | |
| Allow for ubiquitous BA information flow | **I** | | |
| Allow for rapidly deployable BA network | **P** | Transfer to Fn1 | |
| **Rapidly Infuse Technology** | | | |
| Allow for rapid insertion of new technology | **I** | Transfer to Fn14 | |
| Allow for rapid restructuring of BA structure | **I** | Transfer to Fn14 | |

| | | | | | | **Process…Sort…Info** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Domain - - - - >** | | C | C | C | C | C | C | C | C | C | C |
| **Tasks Map for BA to Fn2, 3, 5-C** <br><br>- - - - - - - - - - - - - - - - - - - -<br><br>- **Levels:**<br>**P = Physical**<br>**I = Informational**<br>**C = Cognitive**<br>**O = Organizational** | | Analyze Information | Evaluate Information | Synthesize Information | Deconflict multiple reports | Utilize Simulation for analysis | Conduct Distributed analysis | ID Red patterns of behavior | Defeat denial & deception | Produce Assessments | Distribute Battlespace knowledge |
| **Task (T) or Subtask (S) - - - - >** | | T | S | S | S | T | T | T | T | T | T |
| **BA Operational Capabilities** | | | | | | | | | | | |
| **Command and Control of BA Assets** | | | | | | | | | | | |
| Synchronize ISR with operations | O | | | | | | | | | | |
| Task and dynamically re-task assets | C | | | | | | | | | | |
| Monitor/track assets & their activities | I | | | | | | | | | | |
| Plan | O | | | | | | | | | | |
| Assess | C | | | | | | | | | | |
| **Execute Collection** | | | | | | | | | | | |
| Gain access  (Physical to airspace) | P | | | | | | | | | | |
| Surveil broad areas synoptically | I | | | | | | | | | | |
| Focus/stare on targets of interest | I | | | | | | | | | | |
| Find, identify, and track | I | | | | | | | | | | |

| Capability | Domain | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Employ human resources | I | | | | | | | | | | | |
| Employ open source resources | I | | | | | | | | | | | |
| Measure & monitor environmental conditions | I | | | | | | | | | | | |
| **Exploitation and Analysis** | | | | | | | | | | | | |
| Recognize targets | C | S | | | | | | | | | | |
| Distribute processing | I | | | | | | | T | | | | |
| Information fusion | C | S | | | | | | | | | | |
| Enable analyst collaboration | C | | | | | | S | | | | | |
| Conduct distributed archive | I | | | | | | S | | | | | |
| Collaborate between analytic centers | O | | | | | | S | | | | | |
| ID Red patterns of behavior | C | | | | | | | | | T | | |
| Defeat denial & deception | C | | | | | | | | | | T | |
| **Model, Simulate and Forecast** | | | | | | | | | | | | |
| Auto-populate models & simulations | I | | | | | S | | | | | | |
| ID enemy courses of action | C | | | | | S | | | | | | |
| Integrate adversary & friendly information | I | | | | | S | | | | | | |
| Include cultures, social issues, & resources | C | | | | | S | | | | | | |
| **Manage Knowledge** | | | | | | | | | | | | |
| Smart push/pull information | I | | | | | | | | | | | S |
| Share plan visibility | I | | | | | | | | | | | S |
| Allow producer interactions | I | | | | | | | | | | T | |
| Maintain an open archive | I/P | | | | | | | | | | | S |
| **Battlespace Awareness Enabling Capabilities** | | | | | | | | | | | | |
| **Integrate BA Network** | | | | | | | | | | | | |
| Allow for quality BA information flow | I | | | | | | | | | | | S |
| Allow for timely BA information flow | I | | | | | | | | | | | S |
| Allow for secure BA information flow | I | | | | | | | | | | | S |
| Allow for ubiquitous BA information flow | I | | | | | | | | | | | S |
| Allow for rapidly deployable BA network | P | | | | | | | | | | | |
| **Rapidly Infuse Technology** | | | | | | | | | | | | |
| Allow for rapid insertion of new technology | I | | | | | | | | | | | |
| Allow for rapid restructuring of BA structure | I | | | | | | | | | | | |

**Tasks Map: C2 to Fn6, 7, 8, 11-O**

- - - - - - - - - - - - - - - - -

**Levels:**
**P = Physical**
**I = Informational**
**C = Cognitive**
**O = Organizational**

| | | Fn6 COP/UDOP | | | | | | | | | | | | Fn8 Automate lower-order C2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domain - - - - > | | I | I | I | I | I | I | I | I | I | I | I | C | C | C | C | C | C | C | C | C | C | C |
| Tasks Map column | | Develop an Operational Net Assess | Correlate information elements | Access & manage info repository | Update info products real time | Achieve a COP | Present Blu/Reg/Grey Situation info | Represent info visually | Represent info aurally | Create user-defined representations | Share user-defined visualizations | Represent info temporally | Assess Countermeasures | User specified search for info | Provide automated simulations | Provide targeting solutions | User-defined threshold alerts | Recognize patterns | Suggest changes to user preferences | Make info patterns assertions | Project movement, trends, outcomes | Aggregate data into larger groups | ... solutions |
| Task(T) or Subtask (S) - - - - > | | T | S | S | S | T | S | S | S | S | S | T | T | T | T | T | T | T | T | T | T | T | T |
| **Basic C2 Capabilities** | | | | | | | | | | | | | | | | | | | | | | | |
| **Monitor and Collect Data** | | | | | | | | | | | | | | | | | | | | | | | |
| Develop an Operational Net Assessment | I | T | | | | | | | | | | | | | | | | | | | | | |
| Identify and Track Blue/Red/Gray Forces | I | | | | | | S | | | | | | | | | | | | | | | | |
| Assess Countermeasures | C | | | | | | | | | | | | T | | | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Provide Current and Accurate Data | **I** | S | | | |
| **Develop Situational Understanding** | | | | | |
| Develop Situational Understanding | **C** | | | | |
| Achieve Global Situational Awareness | **C** | | | | |
| Develop Near Real-Time Intelligence | **C** | | T | | |
| Develop Situational Awareness | **C** | | | | |
| Access Immediate Data | **I** | Transfer to F11-I | | | |
| **Develop Courses of Action and Select One** | | | | | |
| Discern and Follow Commander's Intent | **O** | | | | |
| Be Creative | **C** | | | | |
| Provide the Means to Act on Provided Info | **O** | | | | |
| Accurately Predict Events | **C** | | | | T |
| Have Timely, Relevant, Decision-making Info | **I** | Transfer to F11-I | | | |
| **FROM NCE** | | | | | |
| Effectively Collaborate with Other Entities | **O** | | | | |
| Overcome Orgaz/Cultural Limits to Collab | **O** | | | | |
| Establish Trust in Decision-making Collab | **O** | | | | |
| Achieve Situational Awareness | **C** | | | | |
| Communicate SA to Other Decision-makers | **C** | | | | |
| Use Multiple Methods to Achieve SU | **C** | | | | |
| Achieve Higher Quality SU via Mult Means | **C** | | | | |
| Comm Understand to Other Decision-makers | **C** | | | | |
| Make High Quality Decisions | **O** | | | | |
| **Develop a Plan** | | | | | |
| Dev Plan Including Pre/Post Conflict Effects | **O** | | | | |
| Dev Plan Based on Mission Anal & Cdr Intent | **O** | | | | |
| Precisely Derive Adversary CoAs | **C** | | | | |
| Select CoA Based on Capabilities Assmnt | **O** | | | | |
| **Execute Plan, Provide Direction and Leadership** | | | | | |
| Develop and Sustain Unity of Command | **O** | | | | |
| Provide Leadership | **O** | | | | |
| Empower Lower Echelons | **O** | | | | |
| Command Throughout Echelons | **O** | | | | |
| **Monitor Execution and Adapt as Necessary** | | | | | |
| Assess Changes in Adversary's Systems | **C** | | | | |
| Develop, Maintain Adaptive Cmnd Proc | **O** | | | | |
| Develop "Observables" for Assessment | **C** | | S | | |
| Provide Feedback on Operations | **O** | | S | | |
| Assess Decisions | **O** | | | | |
| Achieve Desired Effects | **O** | | | | |
| Conduct Effects-Based Operations | **O** | | | | |
| Re-focus Decisions On Adversary Actions | **O/C** | | | | |

# Collaborative C2 Capabilities

| | | | | | |
|---|---|---|---|---|---|
| **Network** | | | | | |
| Be Networked  (organizationally) | **O** | | | | |
| Comprehensively Connect the Force | **P** | Transfer to Fn1 | | | |
| Utilize Secure and Robust Communications | **I** | Transfer to Fn1 | | | |
| Employ Network Centric Methods | **C/I** | | | | |
| Protect Sensors Info & Info Networks | **I** | Transfer to Fn9 | | | |
| Link the Force in Time and Purpose | **C** | | | | |
| Conduct Simultaneous C2 Functions | **O** | | | | |
| **Share Information** | | | | | |
| Be Decentralized | **O** | | | | |
| Be Adaptable | **O** | | | | |
| Access Data from All Relevant Sources | **I** | | | | |
| Share Collected Information | **I** | | | | |
| Access Horizontally & Vert Integrated Info | **I** | | | | |
| **Interact** | | | | | |
| Be Decentralized | **O** | | | | |

| | | | |
|---|---|---|---|
| Be Adaptable | **O** | | |
| Interact with Interagency & Foreign Entities | **O** | | |
| Interact on Integrated Syst of Global Coms | **O** | | |
| **Develop Shared Awareness** | | | |
| Be Decentralized | **O** | | |
| Be Adaptable | **O** | | |
| Achieve Shared Awareness | **C** | | |
| Achieve a COP | **C/I** | **T** | |
| **Develop Shared Understanding** | | | |
| Be Expeditionary | **O** | | |
| Be Decentralized | **O** | | |
| Be Adaptable | **O** | | |
| Improve Shared Understanding | **C** | | |
| Maintain Shared Understanding | **C** | | |
| **Decide in a Collaborative Environment** | | | |
| Collaboratively Plan | **O** | | |
| Employ Discourse with Subordinates | **O** | | |
| Employ Globally Deployed Collab Plan Envir | **O** | | |
| Orchestrate in Collaborative Planning Envir | **O** | | |
| Collaborate on Commander's Intent | **O** | | |
| **Synchronize** | | | |
| Be Expeditionary | **?** | | |
| Be Decentralized | **O** | | |
| Be Adaptable | **O** | | |
| Employ the Appropriate Joint Capabilities | **O** | | |
| Apply Coalition Resources | **O** | | |
| Employ Combined Forces | **O** | | |
| Apply Interagency Resources | **O** | | |
| Synchronize | **O** | | |
| Conduct Joint Fires | **O** | | |
| Self-Synchronize | **O** | | |

| | | Fn7 Provide Collaborative Environment | | | | | | | | | | | | | | | Fn11-O C2 Interoperability | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domain - - - - > | O | I | C | I | C | C | O | O | C | O | O | O | O | O | O | O | C | C | C | I | O | I | I | P |
| **Tasks Map: C2 to Fn6, 7, 8, 11-O** — — — — — — — — — — — — **Levels: P = Physical I = Informational C = Cognitive O = Organizational** | understanding | Share plans & info products | Collab create alterable work products | Integrate/sync inputs, modes, media | Discern and Follow Cmdr's Intent | makers | Be Networked (organizationally) | Command | Dev Plan Based on Miss Anal & Cdr Int | Assess Decisions | Integrate diverse miss planning | Provide a Collaborative Environment | Form distributed teams, Col | Conduct Effects-Based Operations | Collaboratively Plan | Make High Quality Decisions | Incorporate non-DoD into JC2 | Synchronize | Be Expeditionary | Access Immediate Data | Conduct Joint Fires | Access Data from All Relevant Sources | Share Collected Information | Coms |
| Task(T) or Subtask (S) - - - - > | T | S | S | S | T | T | T | T | T | T | S | T | T | S | T | T | T | T | T | T | T | T | T | T |
| **Basic C2 Capabilities** **Monitor and Collect Data** | | | | | | | | | | | | | | | | | | | | | | | | |

| Task | Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Develop an Operational Net Assessment | I | | | | | | | | | | | |
| Identify and Track Blue/Red/Gray Forces | I | | | | | | | | | | | |
| Assess Countermeasures | C | | | | | | | | | | | |
| Provide Current and Accurate Data | I | | | | | | | | | | | |
| **Develop Situational Understanding** | | | | | | | | | | | | |
| Develop Situational Understanding | C | T | | | | | | | | | | |
| Achieve Global Situational Awareness | C | S | | | | | | | | | | |
| Develop Near Real-Time Intelligence | C | | | | | | | | | | | |
| Develop Situational Awareness | C | S | | | | | | | | | | |
| Access Immediate Data | I | Transfer to F11-I | | | | | | | | | T | |
| **Develop Courses of Action and Select One** | | | | | | | | | | | | |
| Discern and Follow Commander's Intent | O | | | T | | | | | | | | |
| Be Creative | C | | | | | | | | | | | |
| Provide the Means to Act on Provided Info | O | | | | | | S | | | | | |
| Accurately Predict Events | C | | | | | | | | | | | |
| Have Timely, Relevant, Decision-making Info | I | Transfer to F11-I | | | | | | | | | S | |
| **FROM NCE** | | | | | | | | | | | | |
| Effectively Collaborate with Other Entities | O | | | | | | | | | | | |
| Overcome Orgaz/Cultural Limits to Collab | O | | | | | | S | | | | | |
| Establish Trust in Decision-making Collab | O | | | | | | S | | | | | |
| Achieve Situational Awareness | C | S | | | | | | | | | | |
| Communicate SA to Other Decision-makers | C | | | S | | | | | | | | |
| Use Multiple Methods to Achieve SU | C | S | | | | | | | | | | |
| Achieve Higher Quality SU via Mult Means | C | S | | | | | | | | | | |
| Comm Understand to Other Decision-makers | C | | | T | | | | | | | | |
| Make High Quality Decisions | O | | | | | | | | T | | | |
| **Develop a Plan** | | | | | | | | | | | | |
| Dev Plan Including Pre/Post Conflict Effects | O | | | | | S | | | | | | |
| Dev Plan Based on Mission Anal & Cdr Intent | O | | | | | T | | | | | | |
| Precisely Derive Adversary CoAs | C | | | | | S | | | | | | |
| Select CoA Based on Capabilities Assmnt | O | | | | | S | | | | | | |
| **Execute Plan, Provide Direction and Leadership** | | | | | | | | | | | | |
| Develop and Sustain Unity of Command | O | | | | T | | | | | | | |
| Provide Leadership | O | | | | S | | | | | | | |
| Empower Lower Echelons | O | | | | S | | | | | | | |
| Command Throughout Echelons | O | | | | S | | | | | | | |
| **Monitor Execution and Adapt as Necessary** | | | | | | | | | | | | |
| Assess Changes in Adversary's Systems | C | S | | | | | | | | | | |
| Develop, Maintain Adaptive Cmnd Proc | O | | | | S | | | | | | | |
| Develop "Observables" for Assessment | C | | | | | | | | | | | |
| Provide Feedback on Operations | O | | | | | | | | | | | |
| Assess Decisions | O | | | | | T | | | | | | |
| Achieve Desired Effects | O | | | | | | | S | | | | |
| Conduct Effects-Based Operations | O | | | | | | | T | | | | |
| Re-focus Decisions On Adversary Actions | O/C | | | | | | | S | | | | |

# Collaborative C2 Capabilities

| Task | Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Network** | | | | | | | | | | | | |
| Be Networked (organizationally) | O | | | T | | | | | | | | |
| Comprehensively Connect the Force | P | Transfer to Fn1 | | | | | | | | | | |
| Utilize Secure and Robust Communications | I | Transfer to Fn1 | | | | | | | | | | |
| Employ Network Centric Methods | C/I | | | | S | | | | | | | |
| Protect Sensors Info & Info Networks | I | Transfer to Fn9 | | | | | | | | | | |
| Link the Force in Time and Purpose | C | | | | S | | | | | | | |
| Conduct Simultaneous C2 Functions | O | | | | S | | | | | | | |
| **Share Information** | | | | | | | | | | | | |
| Be Decentralized | O | | | | | | | | | S | | |
| Be Adaptable | O | | | | | | | | | S | | |
| Access Data from All Relevant Sources | I | | | | | | | | | | | T |

| Task | Level | Connect with all assets | ID & Awareness all Nodes All Time | Rapidly Deploy BA network | Publish services availability | Publish & subscribe to info | Provide redundant coms channels | Ensure net availability & reliability | Provide sufficient QoS all nodes | Establish Information Environment | Share Stored Information | Establish metadata registries | Establish data/metadata standards | Consume Information | Advertise information | Subscribe | Ensure storage redundancy | Retrieve information | Provide info compliant with standards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Share Collected Information | I | | | | | | | | | | | | | | | | | T | |
| Access Horizontally & Vert Integrated Info | I | | | | | | | | | | | | | | | | | S | |
| **Interact** | | | | | | | | | | | | | | | | | | | |
| Be Decentralized | O | | | | | | | | | | | | | | | S | | | |
| Be Adaptable | O | | | | | | | | | | | | | | | S | | | |
| Interact with Interagency & Foreign Entities | O | | | | | | | | | | | S | | | | | | | |
| Interact on Integrated Syst of Global Coms | O | | | | | | | | | | | | | | | | | | T |
| **Develop Shared Awareness** | | | | | | | | | | | | | | | | | | | |
| Be Decentralized | O | | | | | | | | | | | | | | | S | | | |
| Be Adaptable | O | | | | | | | | | | | | | | | | | | |
| Achieve Shared Awareness | C | S | | | | | | | | | | | | | | | | | |
| Achieve a COP | C/I | | | | | | | | | | | | | | | | | | |
| **Develop Shared Understanding** | | | | | | | | | | | | | | | | | | | |
| Be Expeditionary | O | | | | | | | | | | | | | | | T | | | |
| Be Decentralized | O | | | | | | | | | | | | | | | S | | | |
| Be Adaptable | O | | | | | | | | | | | | | | | S | | | |
| Improve Shared Understanding | C | S | | | | | | | | | | | | | | | | | |
| Maintain Shared Understanding | C | S | | | | | | | | | | | | | | | | | |
| **Decide in a Collaborative Environment** | | | | | | | | | | | | | | | | | | | |
| Collaboratively Plan | O | | | | | | | | | | | T | | | | | | | |
| Employ Discourse with Subordinates | O | | | | | | | | | | | S | | | | | | | |
| Employ Globally Deployed Collab Plan Envir | O | | | | | | | | | | | S | | | | | | | |
| Orchestrate in Collaborative Planning Envir | O | | | | | | | | | | | S | | | | | | | |
| Collaborate on Commander's Intent | O | | S | | | | | | | | | | | | | | | | |
| **Synchronize** | | | | | | | | | | | | | | | | | | | |
| Be Expeditionary | ? | | | | | | | | | | | | | | | T | | | |
| Be Decentralized | O | | | | | | | | | | | | | | | S | | | |
| Be Adaptable | O | | | | | | | | | | | | | S | | | | | |
| Employ the Appropriate Joint Capabilities | O | | | | | | | | | | | | | S | | | | | |
| Apply Coalition Resources | O | | | | | | | | | | | | | S | | | | | |
| Employ Combined Forces | O | | | | | | | | | | | | | S | | | | | |
| Apply Interagency Resources | O | | | | | | | | | | | | | S | | | | | |
| Synchronize | O | | | | | | | | | | | | | | T | | | | |
| Conduct Joint Fires | O | | | | | | | | | | | | | | | | T | | |
| Self-Synchronize | O | | | | | | | | | | | | | | S | | | | |
| **Domain ---->** | | P | I | P | P | P | P | P | P | I | I | I | I | I | I | I | P | I | I |
| **Task (T) or Subtask (S) ---->** | | T | T | T | T | T | T | T | T | T | T | T | S | T | T | T | T | T | T |

**Fn1 — Com All Nodes** (columns: Connect with all assets; ID & Awarenes all Nodes All Time; Rapidly Deploy BA network; Publish services availability; Publish & subscribe to info; Provide redundant coms channels; Ensure net availability & reliability; Provide sufficient QoS all nodes)

**Fn4 — Store/Retrieve Info** (columns: Establish Information Environment; Share Stored Information; Establish metadata registries; Establish data/metadata standards; Consume Information; Advertise information; Subscribe; Ensure storage redundancy; Retrieve information; Provide info compliant with standards)

**Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14**

- - - - - - - - - - - - - - - - - - - - -

Levels:
P = Physical
I = Informational
C = Cognitive
O = Organizational

**NCE Knowledge Area Capabilities**
**Establish Appropriate Organizational Relationships**

| Capability | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Deal with Flexible Authority Relations | O | | | | | | | |
| Maintain Flexible Attitudes to Power & Auth | O | | | | | | | |
| Obtain/Maintain Understanding of Cdr's Int | O | Transfer to Fn7 | | | | | | |
| Flexibly Adapt to Changing Ops Needs | O | | | | | | | |
| **Collaborate** | | | | | | | | |
| Effectively Collaborate with Other Entities | O | Transfer to Fn7 | | | | | | |
| Overcome Orgaz/Cultural Limits to Collab | O | Transfer to Fn7 | | | | | | |
| Establish Trust in Decision-making Collab | O | Transfer to Fn7 | | | | | | |
| **Synchronize Actions** | | | | | | | | |
| Flexibly Adapt Act to Take Advan. of Oppor | O | | | | | | | |
| Flexibly Adapt Act to Min. Impact of Threats | O | | | | | | | |
| **Share Situational Awareness** | | | | | | | | |
| Achieve Situational Awareness | C | Transfer to Fn7 | | | | | | |
| Communicate SA to Other Decision-makers | C | Transfer to Fn7 | | | | | | |
| Simultaneously Process Mult Source Inputs | I | | | | | | | |
| **Share Situational Understanding** | | | | | | | | |
| Use Multiple Methods to Achieve SU | C | Transfer to Fn7 | | | | | | |
| **Conduct Collab Decision-making/Planning** | | | | | | | | |
| Achieve Higher Quality SU via Mult Means | C | Transfer to Fn7 | | | | | | |
| Com Understand to Other Decision-makers | C | Transfer to Fn7 | | | | | | |
| Utilize Virtl Reality Train, Wargaming, Exerc | O | | | | | | | |
| Make High Quality Decisions | O | Transfer to Fn7 | | | | | | |
| **Operate Independently** | | | | | | | | |
| Know Tasks & Teams Assigned to Tasks | O | | | | | | | |
| Know Available Assets Enterprise-Wide | I | | | | | | | |
| Interact Effly with DSTs in Collab Environ | O | | | | | | | |
| Interact/Accept Inputs from Non-Tradit Cols | O | | | | | | | |

# NCE Technical Area Capabilities

| Capability | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Create/Produce Information** | | | | | | | | |
| Collect Data | P | | | | | | | |
| Transform/Process Data Into Information | I | | | | | | | |
| Have Timely, Relevant, Decision-making Info | I | | | | | | | |
| Access Immediate Data | I | | | | | | | |
| **Store/Share/Exchange Information & Data** | | | | | | | | |
| Tag Information | I | | | | | | | |
| Post/Publish Information | I | | | | | S | | |
| Share Stored Information | I | | | | | T | | |
| Advertise Information | I | | | | | S | | |
| Stage Content (Smart Store) | I | | | | | S | | |
| Archive | I | | | | | | | |
| Collaborate | C | | | | | | S | |
| Message | I | | | | | | S | |
| **Establish an Information Environment** | | | | | | | | |
| Establish Criteria for Storing and Sharing | C/I | | | | S | | | |
| Share Access Across Areas | P | | | | S | | | |
| Support Ent-Wide and COI-Specific Appl | I | | | | S | | | |
| Support Dyn, Priortiy-Based Resource Alloc | C | | | | S | | | |
| **Process Data and Information** | | | | | | | | |
| Support Mediation/Translation Services | I | | | | | | | |
| Correlate and Fuse Information | I | | | | | | | |
| Process Information | I | | | | | | | |

| Task | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **Employ Geospatial Information** | | | | | | | | |
|   Link Geograph Info to Underlying Database | C | | | | | | | |
|   Provide Layering and Drill-Down | C | | | | | | | |
| **Employ Information** | | | | | | | | |
|   Display Information | I | | | | | | | S |
|   Enable Machine-to-Machine Info sharing | I | | | | | | S | |
| **Find and Consume Information** | | | | | | | | |
|   Train Using Sims and Mission Rehearsal | C | | | | | | S | |
|   Discover/Search | C | | | | | | S | |
|   Pull/Retrieve/Access | C | | | | | | S | |
|   Subscribe | I | | | | | | | T |
|   Perform Intelligent Search/Smart Pull | C | | | | | | S | |
|   Consume Information | C | | | | | | T | |
| **Provide User Access** | | | | | | | | |
|   Support Role-Based Access Control | C | S | | | | | | |
|   Support Strong Authentication | C | S | | | | | | |
| **Access Information** | | | | | | | | |
|   Support Multi-Level Security | I | | | | | | | S |
|   Share Across Security Areas (Coal., HLS) | I | | | | | | | S |
| **Validate/Assure** | | | | | | | | |
|   Restore/Recover | I | | | | | | | |
|   Assure Information | I | | | | | | | |
|   Validate Information | I | | | | | | | |
|   Determine an Information Pedigree | I | | | | | | | |
|   Develop Trust in the Information | C | | | | | | | |
| **Install/Deploy** | | | | | | | | |
|   Rapidly Deploy/Empl. Robust Connect Fwd | P | S | | | | | | |
|   Rapidly Deploy BA network | P | | | T | | | | |
|   Tailor to Specific Capabilities | I | | | | S | | | |
|   Function Under Range of Infrastruct & ROE | I | S | | | | | | |
|   Dynamic. Plan Net Arch Develop Process | C | S | | | | | | |
| **Operate/Maneuver** | | | | | | | | |
|   Self-Synchronize | C | | | | | | | |
|   ID & Maintain Awareness all Nodes All Time | I | | T | | | | | |
|   Wargame the Network | C | | | | | | | |
|   Operate Without Geographical Constraints | O | S | | | | | | |
|   Support Ops and Transit States on ROMO | O | | | | | | | |
|   Manage Assured Access/Denial | C | | | | | | | |
|   Operate Without Geographical Constraints | P | S | | | | | | |
|   Manage Continuity and Restoration of Ops | C | | | | | S | | |
|   Provide Timely and Reliable Delivery of Info | I | | | | S | | | |
| **Maintain/Survive** | | | | | | | | |
|   Detect and Defend Against logical Attack | C | | | | | S | | |
|   Dynamically Re-Route Services | C | | | | | S | | |
|   Degrade Gracefully, Contain Cascade Fail | C | | | | | S | | |
|   Continue Essential Ops in Degraded Env | C | | | | | S | | |
|   Prioritize Data Flows from DB/Backups | C | | | | | | | |
|   Acq Additional Net Resources on Demand | P | | | | | | | |
| **Provide Network Services** | | | | | | | | |
|   Connect with All Assets | P | T | | | | | | |
|   Connect, Share Info, Interagency/Coalition/NGO | I | | | | | S | | |
|   Easily Search, File, Xfer, Comm., Sprt Net | I | | | | S | | | |
|   Archive Large Amounts of Data | I | | | | | | | |
|   Comprehensively Connect the Force | P | S | | | | | | |
|   Utilize Secure and Robust Communications | I | | | | | S | | |
|   Protect Sensors Info & Info Networks | I | | | | | | | |
|   Rapid restructuring of BA structure ( **BA**) | I | | | | | | | |

| Task | Level | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inform/Update Chain-of-Cmd of Net Status | I | | | | | | | | | | | | | S | | | | | |
| Support Separate Constellations of COIs | P | | | | | | | | | | | | | S | | | | | |
| Support Geograph Transitioning Nodes | P | S | | | | | | | | | | | | | | | | | |

|  |  | **Fn5-I** Proc, Anal... Info | | | | | | | **Fn9** Info Assurance | | | | | | | **Fn10** MLS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Domain ---->** | | I | I | I | I | I | I | I | I | I | I | C | C | C | I | I | I | I | I | I |
| | | Transform/Process Data Into Info | Support Mediation/Translation Services | Sort Information | Correlate reports over time | Simul Process Multiple Source Inputs | Catalog Information | Archive | Authenticate all info and sources | Protect all information | Assure Information | ID info disruption, denial, destruction | ID syst disruption, denial, destruction | Develop Trust in the Information | Restore/Recover | ID clearance of netwok nodes | Track clasification all info | Correlate clearanc with classification | Contol access to information | Sanitize or downgrade as appropriate |
| **Task (T) or Subtask (S) ----->** | | T | T | T | T | T | | | T | T | T | T | T | T | T | T | T | T | T | T |

**NCE Knowledge Area Capabilities**

**Establish Appropriate Organizational Relationships**

| Capability | Domain | Fn5-I col1 |
|---|---|---|
| Deal with Flexible Authority Relations | O | |
| Maintain Flexible Attitudes to Power & Auth | O | |
| Obtain/Maintain Understanding of Cdr's Int | O | Transfer to Fn7 |
| Flexibly Adapt to Changing Ops Needs | O | |

**Collaborate**

| Capability | Domain | |
|---|---|---|
| Effectively Collaborate with Other Entities | O | Transfer to Fn7 |
| Overcome Orgaz/Cultural Limits to Collab | O | Transfer to Fn7 |
| Establish Trust in Decision-making Collab | O | Transfer to Fn7 |

**Synchronize Actions**

| Capability | Domain | |
|---|---|---|
| Flexibly Adapt Act to Take Advan. of Oppor | O | |
| Flexibly Adapt Act to Min. Impact of Threats | O | |

**Share Situational Awareness**

| Capability | Domain | |
|---|---|---|
| Achieve Situational Awareness | C | Transfer to Fn7 |
| Communicate SA to Other Decision-makers | C | Transfer to Fn7 |
| Simultaneously Process Mult Source Inputs | I | |

**Share Situational Understanding**

| Capability | Domain | |
|---|---|---|
| Use Multiple Methods to Achieve SU | C | Transfer to Fn7 |

**Conduct Collab Decision-making/Planning**

| Capability | Domain | |
|---|---|---|
| Achieve Higher Quality SU via Mult Means | C | Transfer to Fn7 |
| Com Understand to Other Decision-makers | C | Transfer to Fn7 |
| Utilize Virtl Reality Train, Wargaming, Exerc | O | |
| Make High Quality Decisions | O | Transfer to Fn7 |

**Operate Independently**

| Capability | Domain | |
|---|---|---|
| Know Tasks & Teams Assigned to Tasks | O | |

Levels:
P = Physical
I = Informational
C = Cognitive
O = Organizational

Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14

| Capability | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Know Available Assets Enterprise-Wide | I | | | | | | | |
| Interact Effly with DSTs in Collab Environ | O | | | | | | | |
| Interact/Accept Inputs from Non-Tradit Cols | O | | | | | | | |
| **NCE Technical Area Capabilities** | | | | | | | | |
| **Create/Produce Information** | | | | | | | | |
| Collect Data | P | S | | | | | | |
| Transform/Process Data Into Information | I | T | | | | | | |
| Have Timely, Relevant, Decision-making Info | I | | | | | | | |
| Access Immediate Data | I | | | | | | | |
| **Store/Share/Exchange Information & Data** | | | | | | | | |
| Tag Information | I | | | | S | | | |
| Post/Publish Information | I | | | | | | | |
| Share Stored Information | I | | | | | | | |
| Advertise Information | I | | | | | | | |
| Stage Content (Smart Store) | I | | | | | | | |
| Archive | I | | | | S | | | |
| Collaborate | C | | | | | | | |
| Message | I | | | | | | | |
| **Establish an Information Environment** | | | | | | | | |
| Establish Criteria for Storing and Sharing | C/I | | | | | | | |
| Share Access Across Areas | P | | | | | | | |
| Support Ent-Wide and COI-Specific Appl | I | | | | | | | |
| Support Dyn, Priority-Based Resource Alloc | C | | | | | | | |
| **Process Data and Information** | | | | | | | | |
| Support Mediation/Translation Services | I | | T | | | | | |
| Correlate and Fuse Information | I | | S | | | | | |
| Process Information | I | S | | | | | | |
| **Employ Geospatial Information** | | | | | | | | |
| Link Geograph Info to Underlying Database | C | | | S | | | | |
| Provide Layering and Drill-Down | C | | | S | | | | |
| **Employ Information** | | | | | | | | |
| Display Information | I | | | | | | | |
| Enable Machine-to-Machine Info sharing | I | | | | | | | |
| **Find and Consume Information** | | | | | | | | |
| Train Using Sims and Mission Rehearsal | C | | | | | | | |
| Discover/Search | C | | | | | | | |
| Pull/Retrieve/Access | C | | | | | | | |
| Subscribe | I | | | | | | | |
| Perform Intelligent Search/Smart Pull | C | | | | | | | |
| Consume Information | C | | | | | | | |
| **Provide User Access** | | | | | | | | |
| Support Role-Based Access Control | C | | | | | | | |
| Support Strong Authentication | C | | | | | | | |
| **Access Information** | | | | | | | | |
| Support Multi-Level Security | I | | | | | | | |
| Share Across Security Areas (Coal., HLS) | I | | | | | | | |
| **Validate/Assure** | | | | | | | | |
| Restore/Recover | I | | | | | | | T |
| Assure Information | I | | | | | T | | S |
| Validate Information | I | | | | | S | | |
| Determine an Information Pedigree | I | | | | | S | | |
| Develop Trust in the Information | C | | | | | | T | |
| **Install/Deploy** | | | | | | | | |
| Rapidly Deploy/Empl. Robust Connect Fwd | P | | | | | | | |
| Rapidly Deploy BA network | P | | | | | | | |
| Tailor to Specific Capabilities | I | | | | | | | |
| Function Under Range of Infrastruct & ROE | I | | | | | | | |
| Dynamic. Plan Net Arch Develop Process | C | | | | | | | |
| **Operate/Maneuver** | | | | | | | | |

| Task | Level | | | |
|---|---|---|---|---|
| Self-Synchronize | C | | | |
| ID & Maintain Awareness all Nodes All Time | I | | | |
| Wargame the Network | C | | | |
| Operate Without Geographical Constraints | O | | | |
| Support Ops and Transit States on ROMO | O | | | |
| Manage Assured Access/Denial | C | | | |
| Operate Without Geographical Constraints | P | | | |
| Manage Continuity and Restoration of Ops | C | | | |
| Provide Timely and Reliable Delivery of Info | I | | | |
| **Maintain/Survive** | | | | |
| Detect and Defend Against logical Attack | C | | | |
| Dynamically Re-Route Services | C | | | |
| Degrade Gracefully, Contain Cascade Fail | C | | | |
| Continue Essential Ops in Degraded Env | C | | | |
| Prioritize Data Flows from DB/Backups | C | | | |
| Acq Additional Net Resources on Demand | P | | | |
| **Provide Network Services** | | | | |
| Connect with All Assets | P | | | |
| Connect, Share Info, Interagency/Coalition/NGO | I | | | |
| Easily Search, File, Xfer, Comm., Sprt Net | I | | | |
| Archive Large Amounts of Data | I | | T | |
| Comprehensively Connect the Force | P | | | |
| Utilize Secure and Robust Communications | I | | | |
| Protect Sensors Info & Info Networks | I | | | S |
| Rapid restructuring of BA structure ( **BA**) | I | | | |
| Inform/Update Chain-of-Cmd of Net Status | I | | | |
| Support Separate Constellations of COIs | P | | | |
| Support Geograph Transitioning Nodes | P | | | |

| | | Fn11-I C2 Interop | | | | | Fn12 Autonomous Nodes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domain - - - - > | | I | I | I | I | P | P | C | C | C | C | C | I | I |
| **Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14** — — — — — — — — — — — — — **Levels:** **P = Physical** **I = Informational** **C = Cognitive** **O = Organizational** | | Establish C2 Systems Standards | Comply with c2 systems standards | Access Immediate Data | Translate syst, formats, protocols | Provide system interface services | Optimize coms with limited thruput | Tasks | Collab Environ | Traditional Cols | Prioritize info requirements | Interpolate/extrapolate patterns | Know Available Assets Enterprise-Wide | Provide recent locational info |
| Task (T) or Subtask (S) - - - - -> | | T | T | T | T | T | T | T | T | T | T | T | T | S |
| **NCE Knowledge Area Capabilities** | | | | | | | | | | | | | | |
| **Establish Appropriate Organizational Relationships** | | | | | | | | | | | | | | |
| Deal with Flexible Authority Relations | O | | | | | | | | | | | | | |
| Maintain Flexible Attitudes to Power & Auth | O | | | | | | | | | | | | | |
| Obtain/Maintain Understanding of Cdr's Int | O | Transfer to Fn7 | | | | | | | | | | | | |
| Flexibly Adapt to Changing Ops Needs | O | | | | | | | | | | | | | |
| **Collaborate** | | | | | | | | | | | | | | |
| Effectively Collaborate with Other Entities | O | Transfer to Fn7 | | | | | | | | | | | | |
| Overcome Orgaz/Cultural Limits to Collab | O | Transfer to Fn7 | | | | | | | | | | | | |

| Capability | Code | | | | | |
|---|---|---|---|---|---|---|
| Establish Trust in Decision-making Collab | O | Transfer to Fn7 | | | | |
| **Synchronize Actions** | | | | | | |
| Flexibly Adapt Act to Take Advan. of Oppor | O | | | | | |
| Flexibly Adapt Act to Min. Impact of Threats | O | | | | | |
| **Share Situational Awareness** | | | | | | |
| Achieve Situational Awareness | C | Transfer to Fn7 | | | | |
| Communicate SA to Other Decision-makers | C | Transfer to Fn7 | | | | |
| Simultaneously Process Mult Source Inputs | I | | | | | |
| **Share Situational Understanding** | | | | | | |
| Use Multiple Methods to Achieve SU | C | Transfer to Fn7 | | | | |
| **Conduct Collab Decision-making/Planning** | | | | | | |
| Achieve Higher Quality SU via Mult Means | C | Transfer to Fn7 | | | | |
| Com Understand to Other Decision-makers | C | Transfer to Fn7 | | | | |
| Utilize Virtl Reality Train, Wargaming, Exerc | O | | | | | |
| Make High Quality Decisions | O | Transfer to Fn7 | | | | |
| **Operate Independently** | | | | | | |
| Know Tasks & Teams Assigned to Tasks | O | | T | | | |
| Know Available Assets Enterprise-Wide | I | | | | | T |
| Interact Effly with DSTs in Collab Environ | O | | | T | | |
| Interact/Accept Inputs from Non-Tradit CoIs | O | | | | T | |

# NCE Technical Area Capabilities

| Capability | Code | | | | | |
|---|---|---|---|---|---|---|
| **Create/Produce Information** | | | | | | |
| Collect Data | P | | | | | |
| Transform/Process Data Into Information | I | | | | | |
| Have Timely, Relevant, Decision-making Info | I | S | | | | |
| Access Immediate Data | I | T | | | | |
| **Store/Share/Exchange Information & Data** | | | | | | |
| Tag Information | I | | | | | |
| Post/Publish Information | I | | | | | |
| Share Stored Information | I | | | | | |
| Advertise Information | I | | | | | |
| Stage Content (Smart Store) | I | | | | | |
| Archive | I | | | | | |
| Collaborate | C | | | | | |
| Message | I | | | | | |
| **Establish an Information Environment** | | | | | | |
| Establish Criteria for Storing and Sharing | C/I | | | | | |
| Share Access Across Areas | P | | | | | |
| Support Ent-Wide and COI-Specific Appl | I | | | | | |
| Support Dyn, Priortiy-Based Resource Alloc | C | | | | | |
| **Process Data and Information** | | | | | | |
| Support Mediation/Translation Services | I | | | | | |
| Correlate and Fuse Information | I | | | | | |
| Process Information | I | | | | | |
| **Employ Geospatial Information** | | | | | | |
| Link Geograph Info to Underlying Database | C | | | | | |
| Provide Layering and Drill-Down | C | | | | | |
| **Employ Information** | | | | | | |
| Display Information | I | | | | | |
| Enable Machine-to-Machine Info sharing | I | | | | | |
| **Find and Consume Information** | | | | | | |
| Train Using Sims and Mission Rehearsal | C | | | | | |
| Discover/Search | C | | | | | |
| Pull/Retrieve/Access | C | | | | | |
| Subscribe | I | | | | | |
| Perform Intelligent Search/Smart Pull | C | | | | | |

| | |
|---|---|
| Consume Information | C |
| **Provide User Access** | |
| Support Role-Based Access Control | C |
| Support Strong Authentication | C |
| **Access Information** | |
| Support Multi-Level Security | I |
| Share Across Security Areas (Coal., HLS) | I |
| **Validate/Assure** | |
| Restore/Recover | I |
| Assure Information | I |
| Validate Information | I |
| Determine an Information Pedigree | I |
| Develop Trust in the Information | C |
| **Install/Deploy** | |
| Rapidly Deploy/Empl. Robust Connect Fwd | P |
| Rapidly Deploy BA network | P |
| Tailor to Specific Capabilities | I |
| Function Under Range of Infrastruct & ROE | I |
| Dynamic. Plan Net Arch Develop Process | C |
| **Operate/Maneuver** | |
| Self-Synchronize | C |
| ID & Maintain Awareness all Nodes All Time | I |
| Wargame the Network | C |
| Operate Without Geographical Constraints | O |
| Support Ops and Transit States on ROMO | O |
| Manage Assured Access/Denial | C |
| Operate Without Geographical Constraints | P |
| Manage Continuity and Restoration of Ops | C |
| Provide Timely and Reliable Delivery of Info | I |
| **Maintain/Survive** | |
| Detect and Defend Against logical Attack | C |
| Dynamically Re-Route Services | C |
| Degrade Gracefully, Contain Cascade Fail | C |
| Continue Essential Ops in Degraded Env | C |
| Prioritize Data Flows from DB/Backups | C |
| Acq Additional Net Resources on Demand | P |
| **Provide Network Services** | |
| Connect with All Assets | P |
| Connect, Share Info, Interagency/Coalition/NGO | I |
| Easily Search, File, Xfer, Comm., Support Net | I |
| Archive Large Amounts of Data | I |
| Comprehensively Connect the Force | P |
| Utilize Secure and Robust Communications | I |
| Protect Sensors Info & Info Networks | I |
| Rapid restructuring of BA structure ( **BA**) | I |
| Inform/Update Chain-of-Cmd of Net Status | I |
| Support Separate Constellations of COIs | P |
| Support Geographic Transitioning Nodes | P |

| | Fn13 Network Manag | Fn14 New Capabilities |
|---|---|---|
| Domain - - - - > | P P C P P P C P | P O C O O O O |

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**Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14**

- - - - - - - - - - - - - - - - - - - - - - -

**Levels:**
**P = Physical**
**I = Informational**
**C = Cognitive**
**O = Organizational**

| Task (T) or Subtask (S) - - - - -> | Lvl | Monitor system usage & performance | Allocate/reallocate C2 resources | Wargame the Network | Manage network accounts | Provide/manage network services on Demand | ID need to intervene in C2 systems / Status | Incorporate new technologies / Needs | Adopt new doctrine & TTP | Rapid restructuring of BA structure | Oppor. | Threats | Create new organizations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T | T | T | T | T | T | T | T | T | T | T | T |
| **NCE Knowledge Area Capabilities** | | | | | | | | | | | | | |
| **Establish Appropriate Organizational Relationships** | | | | | | | | | | | | | |
| Deal with Flexible Authority Relations | O | | | | | | | S | | | | | |
| Maintain Flexible Attitudes to Power & Auth | O | | | | | | | S | | | | | |
| Obtain/Maintain Understanding of Cdr's Int | O | Transfer to Fn7 | | | | | | | | | | | |
| Flexibly Adapt to Changing Ops Needs | O | | | | | | | T | | | | | |
| **Collaborate** | | | | | | | | | | | | | |
| Effectively Collaborate with Other Entities | O | Transfer to Fn7 | | | | | | | | | | | |
| Overcome Orgaz/Cultural Limits to Collab | O | Transfer to Fn7 | | | | | | | | | | | |
| Establish Trust in Decision-making Collab | O | Transfer to Fn7 | | | | | | | | | | | |
| **Synchronize Actions** | | | | | | | | | | | | | |
| Flexibly Adapt Act to Take Advan. of Oppor | O | | | | | | | | | | T | | |
| Flexibly Adapt Act to Min. Impact of Threats | O | | | | | | | | | | | T | |
| **Share Situational Awareness** | | | | | | | | | | | | | |
| Achieve Situational Awareness | C | Transfer to Fn7 | | | | | | | | | | | |
| Communicate SA to Other Decision-makers | C | Transfer to Fn7 | | | | | | | | | | | |
| Simultaneously Process Mult Source Inputs | I | | | | | | | | | | | | |
| **Share Situational Understanding** | | | | | | | | | | | | | |
| Use Multiple Methods to Achieve SU | C | Transfer to Fn7 | | | | | | | | | | | |
| **Conduct Collab Decision-making/Planning** | | | | | | | | | | | | | |
| Achieve Higher Quality SU via Mult Means | C | Transfer to Fn7 | | | | | | | | | | | |
| Com Understand to Other Decision-makers | C | Transfer to Fn7 | | | | | | | | | | | |
| Utilize Virtl Reality Train, Wargaming, Exerc | O | | | | | | | | | | | | |
| Make High Quality Decisions | O | Transfer to Fn7 | | | | | | | | | | | |
| **Operate Independently** | | | | | | | | | | | | | |
| Know Tasks & Teams Assigned to Tasks | O | | | | | | | | | | | | |
| Know Available Assets Enterprise-Wide | I | | | | | | | | | | | | |
| Interact Effly with DSTs in Collab Environ | O | | | | | | | | | | | | |
| Interact/Accept Inputs from Non-Tradit CoIs | O | | | | | | | | | | | | |
| **NCE Technical Area Capabilities** | | | | | | | | | | | | | |
| **Create/Produce Information** | | | | | | | | | | | | | |
| Collect Data | P | | | | | | | | | | | | |
| Transform/Process Data Into Information | I | | | | | | | | | | | | |
| Have Timely, Relevant, Decision-making Info | I | | | | | | | | | | | | |
| Access Immediate Data | I | | | | | | | | | | | | |
| **Store/Share/Exchange Information & Data** | | | | | | | | | | | | | |
| Tag Information | I | | | | | | | | | | | | |
| Post/Publish Information | I | | | | | | | | | | | | |
| Share Stored Information | I | | | | | | | | | | | | |
| Advertise Information | I | | | | | | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Stage Content (Smart Store) | I | | | | | |
| Archive | I | | | | | |
| Collaborate | C | | | | | |
| Message | I | | | | | |
| **Establish an Information Environment** | | | | | | |
| Establish Criteria for Storing and Sharing | C/I | | | | | |
| Share Access Across Areas | P | | | | | |
| Support Ent-Wide and COI-Specific Appl | I | | | | | |
| Support Dyn, Priortiy-Based Resource Alloc | C | | | | | |
| **Process Data and Information** | | | | | | |
| Support Mediation/Translation Services | I | | | | | |
| Correlate and Fuse Information | I | | | | | |
| Process Information | I | | | | | |
| **Employ Geospatial Information** | | | | | | |
| Link Geograph Info to Underlying Database | C | | | | | |
| Provide Layering and Drill-Down | C | | | | | |
| **Employ Information** | | | | | | |
| Display Information | I | | | | | |
| Enable Machine-to-Machine Info sharing | I | | | | | |
| **Find and Consume Information** | | | | | | |
| Train Using Sims and Mission Rehearsal | C | | | | | |
| Discover/Search | C | | | | | |
| Pull/Retrieve/Access | C | | | | | |
| Subscribe | I | | | | | |
| Perform Intelligent Search/Smart Pull | C | | | | | |
| Consume Information | C | | | | | |
| **Provide User Access** | | | | | | |
| Support Role-Based Access Control | C | | | | | |
| Support Strong Authentication | C | | | | | |
| **Access Information** | | | | | | |
| Support Multi-Level Security | I | | | | | |
| Share Across Security Areas (Coal., HLS) | I | | | | | |
| **Validate/Assure** | | | | | | |
| Restore/Recover | I | | | | | |
| Assure Information | I | | | | | |
| Validate Information | I | | | | | |
| Determine an Information Pedigree | I | | | | | |
| Develop Trust in the Information | C | | | | | |
| **Install/Deploy** | | | | | | |
| Rapidly Deploy/Empl. Robust Connect Fwd | P | | | | | |
| Rapidly Deploy BA network | P | | | | | |
| Tailor to Specific Capabilities | I | | | | | |
| Function Under Range of Infrastruct & ROE | I | | | | | |
| Dynamic. Plan Net Arch Develop Process | C | | | | | |
| **Operate/Maneuver** | | | | | | |
| Self-Synchronize | C | | | | | |
| ID & Maintain Awareness all Nodes All Time | I | | | | | |
| Wargame the Network | C | T | | | | |
| Operate Without Geographical Constraints | O | | | | | |
| Support Ops and Transit States on ROMO | O | | S | | | |
| Manage Assured Access/Denial | C | | S | | | |
| Operate Without Geographical Constraints | P | | | | | |
| Manage Continuity and Restoration of Ops | C | | | | | |
| Provide Timely and Reliable Delivery of Info | I | | | | | |
| **Maintain/Survive** | | | | | | |
| Detect and Defend Against logical Attack | C | | | | | |
| Dynamically Re-Route Services | C | | | | | |
| Degrade Gracefully, Contain Cascade Fail | C | | | | | |
| Continue Essential Ops in Degraded Env | C | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Prioritize Data Flows from DB/Backups | C | | | S | | |
| Acq Additional Net Resources on Demand | P | | | T | | |
| **Provide Network Services** | | | | | | |
| Connect with All Assets | P | | | | | |
| Connect, Share Info, Interagency/Coalition/NGO | I | | | | | |
| Easily Search, File, Xfer, Comm., Sprt Net | I | | | | | |
| Archive Large Amounts of Data | I | | | | | |
| Comprehensively Connect the Force | P | | | | | |
| Utilize Secure and Robust Communications | I | | | | | |
| Protect Sensors Info & Info Networks | I | | | | | |
| Rapid restructuring of BA structure ( **BA**) | I | | | | T | |
| Inform/Update Chain-of-Cmd of Net Status | I | | | T | | |
| Support Separate Constellations of COIs | P | | | | | |
| Support Geograph Transitioning Nodes | P | | | | | |

## Appendix B.  FORCEnet Task-Level Attributes and Example Measures Table

The following table presents attributes and example measures for FORCEnet tasks.

### Table B.  FORCEnet Task-Level Attributes and Example Measures

| Major Tasks | Attributes | Example Measures |
|---|---|---|
| 1.1 Establish the network | Extensive | *Number* of nodes served by the network. |
| | Sufficient | *Fraction* of nodes requesting service that receive it. |
| | Timely | *Time* difference between network services required and provided (min). |
| 1.2 All nodes access the network | Accessible | *Number* of steps required to log on network |
| | | *Amount of time* required to log in and have access to the network. |
| | | *Percent* of time communications channels are available. |
| | Compatible | *Percent*  of nodes able to authenticate identity. |
| | Extensive | *Percent* of required nodes able to access network. |
| | | *Number* of different types of nodes that can access the network. |
| | | *Percent* of nodes that can communicate using desired access mode, information format, applications. |
| | | *Number* of nodes that can be provided acceptable service at same time. |
| 1.3. All nodes publish their presence, identity and available services | Accessible | *Percent* of nodes able to publish presence/identity and offer available services. |
| | | *Percent* of provided services available, by requesting node. |
| | Manageable | *Time* required to make services available after request, by service. |
| | Sufficient | *Percent* of required services available on the network. |
| 1.4. Maintain a dynamic directory of all nodes that is available to all nodes | Accessible | *Percent* of nodes whose identity can be queried and established. |
| | Manageable | *Seconds* required to identify any node on the network. |
| | | *Seconds* required to publish presence/identity, offer available services. |
| | Sufficient | *Percent* of nodes identifiable to any node. |
| 1.5. All nodes publish information or requests for information to the network. | Accessible | *Percent* of nodes able to publish/subscribe. |
| | | *Percent* saturation of communication channels. |
| | Compatible | *Number* of types of nodes able to publish/subscribe. |
| | | *Number* of different types of nodes that publish or subscribe information. |
| | Sufficient | *Percentage* of collected information that is posted/transmitted/received. |
| | | *Percent* of number of data packets requested that are delivered. |
| | | Maximum data *throughput* (bits/sec). |
| | Usable | *Time* required to publish or subscribe information, by node. |
| | | *Number* of different types of nodes that publish or subscribe information. |
| 1.6. All nodes subscribe to desired information from the network. | Accessible | *Percent* of nodes able to publish/subscribe. |
| | | *Percent* saturation of communication channels. |
| | Compatible | *Number* of types of nodes able to publish/subscribe. |
| | | *Number* of different types of nodes that publish or subscribe information. |
| | Sufficient | *Percentage* of collected information that is posted/transmitted/received. |
| | | *Percent* of number of data packets requested that are delivered. |
| | | Maximum data *throughput* (bits/sec). |
| | Usable | *Time* required to publish or subscribe information, by node. |
| | | *Number* of different types of nodes that publish or subscribe information. |

| | | |
|---|---|---|
| 1.7. Push selected information directly to nodes that have not subscribed to it. | Compatible | *Fraction* of the information required by a node required for its operation that is pushed without intervention. |
| | Flexible | *Number* of different information profiles that can be pushed. |
| | | Push/pull of information integrated to achieve timelines (yes, no). |

| | | |
|---|---|---|
| 2.1 Each node publish extensive operational/mission-oriented information on itself—such as location, status, plans or intentions. | Assured | Horizontal and vertical geolocation *accuracy* in *feet*. |
| | | *Percent* of reports for which unit identity can be confirmed as correct. |
| | | *Percent* of nodes that have accurate, current location information. |
| | Sufficient | *Number* of different types of nodes reporting. |
| | | *Number* of different status dimensions reported by any node. |
| | | *Percent* of units reporting. |
| | Timely | Frequency in *seconds/minutes* that information is updated. |
| | | *Percent* of nodes that update within established timelines. |
| 2.2 Identify, calculate, report and update positions of friendly units, elements or entities that are not able to function as direct nodes on the network. | Assured | *Percent* of non-reporting units for which position and status reports is determined to be correct. |
| | | Subjective determination that status determination of non-reporting units is accurate enough to be operationally useful (useful, marginal, not useful). |
| | Capable | *Number* of units that can be tracked without their reporting. |
| | Timely | Amount of time required to determine non-reporting units characteristics. |
| | | *Percent* of non-reporting units for which a position is maintained within a given period of time. |
| | | Average in *minutes/hours* within which a given non-reporting friendly location is updated. |

| | | |
|---|---|---|
| 3.1. Deploy/maneuver collection assets into position as necessary to collect against a designated target (e.g., penetrate hostile airspace, penetrate a communications network, infiltrate an organization). | Timely | *Time* from request to asset in position for surveillance. |
| | Sufficient | *Fraction* of required airspace available for surveillance. |
| | | *Fraction* of requested area that can be surveilled. |
| 3.2. Persistently collect information on designated targets. | Assured | *Percent* of AO without reconnaissance and surveillance. |
| | | *Percent* of reconnaissance/surveillance missions conducted in accordance with assigned parameters. |
| | Sufficient | *Rate* of area surveillance (square km/hr). |
| | | *Percentage* of targets located within allocated on-location time. |
| | Manageable | *Number* of means available to obtain required information, by info type. |
| | | *Fraction* of information types for which capture means are available and can be tasked. |
| | Timely | *Minutes* since latest information collected/published. |
| | | Gaps in coverage of a given target in *seconds/minutes*. |
| | | *Time* required to locate target area. |
| | | *Time* required to locate target once sensor scans appropriate area. |
| | | *Minutes* since meteorological data updated. |

| | | Hours since oceanographic data updated. |
|---|---|---|
| | | Months since geospatial data updated. |
| 3.3. Publish information on environmental, neutral, unknown and hostile elements, locations, networks, activities, events, sites, platforms, facilities and individuals. | Assured | Horizontal and vertical geolocation accuracy in *feet*. |
| | | *Percent* level of assuredness of location. |
| | | *Percent* of tracks with correct ids. |
| | | *Percent* of quality scores on quality/utility assessments that fall within average. |
| | Sufficient | *Number* of targets/day detected, classified, identified. |
| | | *Percent* of targets/day accurately located, classified/identified. |
| | | *Percent* of PIRs satisfied. |
| | | *Percent* of outstanding PIRs. |
| | | *Percent* of enemy offensive actions for which warning provided. |
| | | *Percent* of nodes receiving indications and warning. |
| | | *Percent* of time-critical targets engaged successfully. |
| | | *Instances* of failure to respond to RFI. |
| | | *Percent* of PIRs with more than one collection source. |
| | Timely | *Hours* to satisfy RFI. |
| | | *Seconds/minutes/hours/days* from collection to publishing. |
| | | *Percent* of manned reconnaissance missions requiring current intelligence that have it before execution. |
| | | *Seconds/minutes/hours* to convert in situ measurements into environmental profiles. |

| | | |
|---|---|---|
| 4.1 Store Information | Assured | *Percent* of information for which source cannot be identified. |
| | | *Percent* of time storage media are available. |
| | Flexible | *Number* of paths/entry points available to access information. |
| | | Number of formats available. |
| | | Number of types of information that can be stored. |
| | Robust | *Number* of different locations a datum can be located. |
| | | *Percent* of all data stored in redundant databases. |
| | Structured | Subjective determination of *ease* of navigating paths to locate desired data (easy, adequate, difficult). |
| | | *Existence* of a catalog that provides map to data location (yes, no). |
| | Sufficient | *Percent* of all created information that is stored. |
| 4.2 Archive information | Assured | *Percent* of information for which source cannot be identified. |
| | | *Percent* of time storage media are available. |
| | Flexible | *Number* of paths/entry points available to access information. |
| | | Number of formats available. |
| | | Number of types of information that can be stored. |
| | Robust | *Number* of different locations a datum can be located. |
| | | *Percent* of all data stored in redundant databases. |
| | Structured | Subjective determination of *ease* of navigating paths to locate desired data (easy, adequate, difficult). |
| | | *Existence* of a catalog that provides map to data location (yes, no). |

| | Sufficient | *Percent* of all created information that is stored. |
|---|---|---|
| | Structured | Structure conforms with established standards (yes, no). |
| | Assured | *Percent* of data that is correctly translated. |
| | Capable | *Number* of systems information that can be translated. |
| | Effective | *Percent* of data that is translated. |
| 4.3. Import into network storage and translate information from external sources not subject to DOD information standards. | Flexible | *Number* of different systems information that can be translated from/to, by information type. |
| | | *Number* of formats accommodated. |
| | | *Translation* between formats available (yes, no). |
| | Timely | *Seconds/minutes/hours* to translate data (from receipt of request). |
| | Usable | Subjective determination of *usability* of information after translation (fully, marginal, unusable) |
| | | *Number* of errors generated during translation. |
| 4.4. Establish and maintain metadata registries defining the structure, format and definitions of data. | Sufficient | *Percent* of available data formats described by the registry. |
| | | Subjective determination of *adequacy* of the registry for describing contained data (1 to 5 scale; 1 fully adequate, 5 inadequate). |
| | Structured | *Average number* of categories of metadata for all data. |
| 4.5. Catalog information according to the structure provided in metadata registries. | Sufficient | *Percent* of all information that is catalogued. |
| | | *Percent* of derived information linked to source data. |
| | | *Percent* of information that is prioritized. |
| | Usable | Subjective determination of *adequacy* of the catalog for describing and locating data (1 to 5 scale; 1 fully adequate, 5 inadequate). |
| | | *Percent* of all information that is catalogued properly by subject, source, geolocation, priority and users/modifiers of information. |
| 4.6. Search for and retrieve information. | Accessible | *Percent* of all information that can be retrieved by any node. |
| | | *Number* of steps required to retrieve information. |
| | | *Percent* of all nodes that can retrieve information. |
| | Timely | *Time* elapsed from information request to receipt. |
| | Usable | *Seconds* required to retrieve any information. |
| | | *Number* of required data fields that are blank. |
| | | *Percent* of retrieved information that corresponds to information sought. |

| | | |
|---|---|---|
| 5.1. Ensure access to source data before and after any processing. | Accessible | Percent of information that is linked to its source data. |
| 5.2. Process source data into information. | Assured | *Percent* of data that is correctly processed. |
| | Capable | *Number* of systems information that can be processed. |
| | Effective | *Percent* of data that is processed. |
| | Flexible | *Number* of different systems information that can be processed, by information type. |
| | | *Number* of information system types. |
| | Timely | *Seconds/minutes/hours* to process data (from receipt). |
| | Usable | Subjective determination of *usability* of information after processing (fully, marginal, unusable) |

| | | |
|---|---|---|
| | | *Number* of requests for clarification of information, by information type. |
| 5.3. Sort information (refers to arranging information according to categories or classes of metadata—e.g., by source, time, subject, etc.). | Assured | *Number* of instances of information placed in wrong category. |
| | Capable | *Number* of types of information that can be sorted. |
| | Effective | *Percent* of data that is sorted. |
| | Flexible | *Number* of information types that can be sorted from different systems, by information type and system. |
| | Timely | *Seconds/minutes/hours* to translate data (from receipt of request). |
| | Usable | Subjective determination of *usability* of information after sorting (fully, marginal, unusable) |
| | | *Number* of errors generated during translation. |
| 5.4. Correlate information (refers to the sequencing of multiple inputs on the same object). | Assured | *Number* of instances of losing information pedigree after correlation. |
| | | Percent of instances correlated tracks preserve original ID. |
| | Capable | *Number* of types of information/tracks that can be correlated. |
| | Effective | Subjective determination of *value* of correlated information (high, medium, low). |
| | Flexible | *Number* of different presentations that can be accomplished with correlated information. |
| | Timely | *Seconds/minutes/hours* to correlate information. |
| | Usable | Subjective determination of *usability* of correlated information (fully, marginal, unusable) |
| | | *Number* of errors generated during correlation. |
| 5.5. Deconflict multiple source inputs on a single object. | Assured | *Number/percent* of redundant data (tracks) that can be eliminated through correlations |
| | | *Percent* of resultant tracks that have correct ID after deconfliction. |
| | Capable | *Number* of types of information/tracks that can be deconflicted. |
| | Effective | *Percent* of cases that can be deconflicted. |
| | Flexible | *Number* of different presentations that can be accomplished with deconflicted information. |
| | Sufficient | *Percent* of multiple sources deconflicted. |
| | Timely | *Seconds/minutes/hours* to deconflict multiple reports. |
| | Usable | Subjective determination of *usability* of deconflicted information (fully, marginal, unusable) |
| | | *Number* of tracks that have lost needed information during deconfliction. |
| 5.6. Analyze information (refers to studying or determining the nature of a subject, usually by breaking it down into its constituent parts and then describing there relationships to each other and the whole). | Assured | *Percentage* of analyzed information that correctly describes object. |
| | | *Percentage* of analysis cases that provide correct object ID. |
| | Capable | *Number* of types of objects/information that can be analyzed. |
| | | *Number* of types of analyses that can be performed. |
| | Sufficient | *Fraction* of requested analyses that can be performed. |
| | Flexible | *Number* of different aspects of an object that can be described. |
| | | *Number* of ways/paths by which an analysis can be reported. |
| | Timely | *Minutes/hours/days* to analyze information. |
| | Usable | Subjective determination of analysis *usability* (fully, marginal, unusable) |
| | | *Fraction* of analyses, by type, that contain all requested information. |
| | | *Number* of requested information packets missing from analysis, by analysis type. |

| | | |
|---|---|---|
| 5.7. Evaluate information (a form of analysis that refers to judging the significance, worth, condition, reliability, etc. of information) | Assured | Subjective determination of level of *confidence* in evaluation's correctness (1-5 scale; 1 fully confident, 5 no confidence). |
| | | *Number* of cases where incorrect information is judged reliable. |
| | Flexible | *Number* of types of evaluation that can be accomplished. |
| | Sufficient | Subjective determination of whether evaluation contains *all* needed information (yes, no). |
| | | *Number* of requested components of evaluation that are missing. |
| | Timely | *Minutes/hours/days* to evaluate information. |
| | Usable | Subjective determination of *Pertinence* of evaluation to operational situation (pertinent, marginal, doesn't apply). |
| 5.8. Identify and predict activity or other patterns. | Assured | *Confidence value* of evaluated data/information |
| | | Subjective determination of *correlation* between prediction and observed situations or outcomes (high, partial, none). |
| 5.9. Synthesize information (refers to the cognitive process of combining elements of information and knowledge to form a more complex whole) | Assured | *Confidence value* of synthesized data/information. |
| | | *Number* of cases where synthesis loses basis of information. |
| | Capable | *Number* of types of information that can be accessed and synthesized. |
| | Effective | *Percent* of information sources that refer to the same situation/object that can be synthesized. |
| | Flexible | *Number* of different presentations that can be accomplished with synthesized information. |
| | Sufficient | *Percent* of available multiple information types/sources synthesized. |
| | | *Percent* of required syntheses that can be performed. |
| | Timely | *Minutes/hours/days* to synthesize information. |
| | Usable | Subjective determination of *usability* of synthesized information (fully, marginal, unusable) |

| | | |
|---|---|---|
| 6.1 Represent information visually, i.e., imagery, graphical, textual, tabular, schematic, geospatial or some other visible form. | Compatible | *Number* of required data elements missing in a representation, by visual representation type. |
| | | Subjective determination of degree to which a visual representation *meets the requirements* of each user, by user (1-5 scale: 1 fully, 5 unmet) |
| | Flexible | *Number* of different visual modes or forms in which any piece of information can be represented. |
| | | *Number* of visual representations that can be displayed at one time. |
| | | *Number* of different user specialized representations that can be met. |
| | Usable | *Number* of requests for clarification of a visual representation, by representation type. |
| | | *Number* of steps required to switch from one representation to another. |
| 6.2 Represent information aurally | Compatible | Ability to correlate aural with other sources of the same information (transparent, can do, difficult). |
| | Flexible | *Percent* of aural source data represented aurally |
| | Sufficient | *Fraction* needed alerts that are provided aurally. |
| | | *Aural* alert is of suffidient vloume/quality that attention is captured (yes, no). |
| | Usable | *Fidelity* of aural presentation (high, medium, low). |
| | | Subjective view of understandability (high, medium, low). |

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| | Compatible | *Number* of required data elements missing in a representation, by representation type. |
| 6.3 Represent information in multiple sensory modes as appropriate. | | Subjective determination of degree to which each representation *meets the requirements* of each user, by user (1-5 scale: 1 fully, 5 unmet) |
| | Flexible | *Number* of different modes or forms in which any piece of information can be represented. |
| | | *Number* of different user specialized representations that can be met. |
| | Usable | *Number* of requests for clarification of a representation, by representation type. |
| | | *Number* of steps required to switch from one representation to another. |
| 6.4 Correlate elements of visual, aural and other information. | Compatible | Subjective determination of degree to which representations are correlated (1-5 scale: 1 fully, 5 unmet) |
| | Flexible | *Number* of different elements of information that can be correlated. |
| | | *Number* of data elements within each representation that can be correlated. |
| | Usable | Subjective determination of *ease* of relating new representation to the former when switching from one representation to another (easy, study required, difficult) |
| | | *Number* of times switching between representations to determine correlation between information elements. |
| 6.5 Represent temporal and spatial object relationships. | Assured | *Mean Accuracy* of object location for a sequence of location reports for a moving object (meters). |
| | | *Maximum reported location error* for all reported locations (meters). |
| | Timely | *Rate* of information updates (number/min). |
| | | *Time delay* between location determination and presentation. |
| | Sufficient | *Number* of locations presented per mile of object motion. |
| | | *Distance* object moves before last position report is posted. |
| 6.6 Integrate friendly, enemy, environmental and other information into a single representation as desired. | Effective | Subjective determination of *ease* of understanding relationship between Red and Blue forces in the representation (1-5 scale: 1 easy, 5 difficult). |
| | | Subjective determination of *ability* to predict red and Blue movements and their interactions with the representation (1-5 scale: 1 easy, 5 difficult). |
| | Flexible | *Number* of different icon representations that can be used to designate units. |
| | | *Number* of different force representations that can be presented: red only; blue only; red, blue, white; etc. |
| | Usable | *Ability* to highlight individual units and drill down to their information with point and click (yes, no). |
| 6.7 From a common set of available data, any node create and update a unique, user-defined representation of the situation as it applies to that node, including any plans, guidance, control measures, etc. as may apply. | Flexible | *Number* of different modes or forms of information that can be incorporated into a single situational representation. |
| | Timely | *Seconds/minutes/hours* lag between real-world situation and situational representation. |
| | | *Time* lapse between request and production of user representation. |
| | Usable | *Percent* of user requested representations that can be produced. |
| | | Subjective determination of degree of *completeness* for the representation meeting their requirements (fully, partially, largely unmet). |

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| 7.1 Each node share | Accessible | *Number* of steps required for a node to access a product, by product. |

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| user-defined plans, visualizations, work products or other information objects with other nodes. | | *Percent* of on-line nodes that can post and share their products. |
| | | *Number* of nodes that can share an information product at one time. |
| | Extensive | *Percentage* of information products that can be shared among nodes. |
| | | *Number* of types of information products that can be shared among nodes. |
| | | *Number* of nodes that can share an information product at one time. |
| | Manageable | *Ability* present to visually relate information in products from different nodes (yes, no) |
| | | *Ability* present to visually highlight the information product from a node for use in the collaboration (yes, no) |
| | Structured | Information packages can be visually related to the node that provided them (yes, no) |
| 7.2. Provide the means for decision makers to interact in the comparison and assessment of shared plans, visualizations, work products or other information objects in order to reach mutual understanding. | Assured | *Fraction* of information products provided for collaboration that include their source and validity. |
| | | Log of sources used and development history available for products (yes, no). |
| | | Collaboration products include visual ID of their contributers (yes, no). |
| | Flexible | *Number* of nodes that can synchronously or asynchronously contribute to the creation of a work product. |
| | | *Number* of types of products that can be used in collaborative sessions. |
| | Timely | *Fraction* of work products that are available to other users in time to meet their deadlines. |
| | | *Latency* between product posting and availability for collaboration (sec). |
| 7.3. Provide the capability for nodes readily to form communities of interest based on access to desired services and expertise available on the network. | Accessible | *Percent* of units wishing to join groups that are able to do so. |
| | | *Number* of steps required to join desired group. |
| | Capable | *Instances* of new groups established after initial organization. |
| | | *Instances* of new nodes incorporated into existing groups after initial organization. |
| | Extensive | *Percent* of required augmentees identified and incorporated into existing groups. |
| | | *Percent* of distributed groups composed on non-organic/non-military/non-US nodes. |
| | | *Number* of groups formed. |
| | Manageable | *Number* of groups a unit can join and maintain cognizance of situations. |
| | | *Number* of groups that can be operating at a time and be supplied with required information. |
| | Structured | Groups formed in accordance with required COIs (yes, no). |
| | | *Fraction* of groups supplied with correct information for their tasks. |
| 7.4. Provide the means collaboratively to create commonly-alterable work products or information objects—such as plans, orders, graphics, analyses, estimates | Assured | *Number* of collaboration products that can't be traced to their source. |
| | | Collaboration products include visual ID of their source (yes, no). |
| | Flexible | *Number* of nodes that can synchronously or asynchronously contribute to the creation of a work product. |
| | | *Number* of types of products that can be produced collaboratively. |
| | Timely | *Fraction* of work products that are available to other users in time to meet their deadlines. |
| | | *Latency* between product posting and availability for collaboration (sec). |
| 7.5. Incorporate | Accessible | *Number* of steps required to access synthesized products. |

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| multiple input modes or media—such as voice, text, sketch, graphics, mapping, imagery, live feeds, etc.—into a single collaboration session. | Extensive | *Percentage* of information products that can be synthesized. |
| | | *Number* of syntheses that can be displayed simultaneously. |
| | | *Number* of types of syntheses that can be produced. |
| | Manageable | *Ease* of producing new syntheses upon request (easy, moderate, difficult) |
| | | *Number* of steps required to produce a new synthesis. |
| | Structured | Synthesized information products can be visually related to each other (yes, no) |
| | | Synthesized information products can be visually related to their source information (yes, no) |
| 7.6. Incorporate diverse, mission-specific planning applications into a single collaboration session. | Accessible | *Fraction* of collaboration units that can access all planning systems |
| | Assured | Fraction of planning-system information that contain a system ID. |
| | | System provided planning products can be traced to their source information (yes, no). |
| | Flexible | *Number* of different mission-planning technologies that can be incorporated into a single collaboration session. |
| | | *Percent* of information that cannot be shared between technologies during a collaboration session. |
| 7.7. Manage collaboration sessions and processes—such as scheduling, establishing objectives and procedures, and assigning permissions and authorities, etc. | Extensive | *Number* of types of collaboration issues that have preset management procedures. |
| | | *Number* of collaboration sessions that can be accommodated while meeting required response times. |
| | | *Percent* of nodes that can be included in arriving at the solution of a management issue. |
| | Manageable | *Percent* of instances that collaboration service is available upon request. |
| | | Adequacy of provided SOP to form collaboration units and for conduct of collaboration sessions (1-5scale: 1 adequate, 5 inadequate). |
| | | *Number* of steps required to solve management issues, by issue type. |
| | Structured | *Number* of collaboration structures that are available preset. |
| | | Adequacy of map of collaboration structure to guide sessions to join and how to access (1-5 scale: 1 adequate, 5 inadequate). |
| | | Collaboration structure map and topical indexes available to guide collaborators to appropriate sessions (yes, no). |
| | Timely | *Seconds* required to establish a collaboration session. |
| | | *Seconds* to broadcast an application. |
| | | *Seconds* to transfer a file to other nodes. |
| | | *Seconds* to create a virtual space. |

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| 8.1 Search for desired information or patterns of information as specified by users | Assured | Percent of patterns that are delivered with information pedigree specified. |
| | Flexible | *Number* of different recognizable patterns. |
| | | *Number* of different sources that can be used to build patterns. |
| | Structured | *Percent* of useful categories/classes defined. |
| | | User specified patterns archived and cataloged for reuse (yes. no). |
| | Timely | *Seconds* to locate desired information or pattern of information. |
| | | Seconds to build pattern assessment from source information. |
| 8.2 Suggest changing | Capable | *Percent* of suggested changes adopted by users. |

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| human-computer-interface preferences based on individual usage patterns. | Flexible | *Number* of preference profiles that can be used/stored for a user. |
| | | *Number* of user profiles that can be implemented at one time. |
| 8.3. Provide alerts based on user-defined thresholds, such as dipping below specified supply thresholds or a report received pertaining to a specific priority information requirement. | Flexible | *Number* of means with which an alert can be delivered. |
| | | *Number* of defined thresholds for an alert. |
| | Structured | *Percent* of alerts that have defined operational responses/SOP. |
| | | Number of alert levels that have defined, quantitative, operational parameters for each component of the alert assessment. |
| | Timely | *Latency* of alert with respect to alert conditions met. |
| | | Update *rates* of information required to produce alerts. |
| 8.4. Aggregate data elements into larger groupings, such as tracking overall logistical status by aggregating status of reporting nodes. | Assured | *Percent* of aggregation cases that misrepresent one or more included data elements. |
| | | *Percent* of aggregations that provide access to included data. |
| | Flexible | *Number* of different types of aggregations that can be calculated. |
| | | *Number* of different types of data that can be used in preparing an aggregation. |
| | Structured | *Percent* of aggregations that satisfy a prescribed operational information requirement. |
| | | Existence of  a catalog of available aggregations (yes, no). |
| 8.5. Provide multi-source correlation and fusion of data. | Flexible | *Number* of different types of data that can be fused. |
| | Structured | Provisions for identifying sources in fused data (yes, no) |
| | Timely | *Time* required to fuse new data with existing,by data type (sec). |
| 8.6. Recognize and predict temporal, spatial, economical, political, cultural or other patterns. | Capable | *Number* of cross-correlations programmed into the system. |
| | | Number of pattern triggers built into the system that prompt changes in situation assessment. |
| | | *Percent*  of assertions that prove true, based on statistical data. |
| | | *Number* of assertions that lead to requests for information updates by users. |
| | Flexible | *Number* of different dimensions (temporal, spatial, content, etc.) in which patterns can be recognized. |
| | | *Number/types* of assertions that can be made about information. |
| | | *Number* of information patterns that are programmed for recognition. |
| | | *Number* of information pattern types for which automated alerts are provided. |
| | | *Number* of different recognizable patterns. |
| | Timely | Time to alert to a pattern change after receiving a change in input parameters of situation prompt. |
| | | *Time* between pattern change recognition and change assessment transmission/receipt. |
| 8.7 Provide automated simulations to support course-of-action evaluation or other purposes. | Assured | Percent of simulation output that is delivered with relevant model assumptions/parameters provided. |
| | | Percent of simulation output that is delivered with simulation run context provided. |
| | Effective | *Percent* of predicted outcomes that prove true, based on statistical data for any given simulation. |
| | Structured | *Percent* of all operational/enterprise dynamics defined that can be simulated. |

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| | | Percent of simulation output that correspond to operational parameters of interest. |
| | Usable | *Level of complexity* of dynamics that can be simulated. |
| | | Degree of correspondence of simulation run to situation of interest (high, partial, uncorrelated). |
| 8.8. Provide automated solutions to computational problems, such as targeting, logistics, or navigation solutions, etc.—especially time-critical functions that exceed human capacity (e.g., "Auto Special" mode in Aegis). | Assured | *Percent* of solutions that utilize operationally current information. |
| | | *Percent* of solutions that provide references to information pedigree used for the assessment. |
| | Effective | *Percent* of targets accurately located, classified/identified. |
| | Timely | *Seconds/hours/ days* to produce a targeting solution for any target. |
| | | Latency of assessment with respect to operational parameter updates. |
| 8.9. Recommend management decisions based on optimization—such as changing distribution priorities or production schedules. | Assured | *Fraction* of available supply-chain data used in providing schedules. |
| | | Fraction of schedules that provide link to underlying data to establish schedule validity. |
| | Capable | *Number* of possible schedules considered/prepared from which choice was made. |
| | | Subjective assessment of *correlation* between schedule and favorable supply outcomes (1-5 scale: 1 highly, 5 poorly correlated). |
| | Timely | *Minutes* to generate complete schedules. |
| | | *Latency* between situation change and new solution (min, hours). |
| | | *Latency* between situation change and alert to management  (min). |
| | | *Percent* of solutions provided within planning timelines. |
| | Usable | *Number/percent* of executable schedules generated. |
| | | *Number* of schedules generated that are sent back for rework. |
| 8.10. Recommend potential options in support of human decision makers exercising judgment, e.g., as in the development of courses of action. | Assured | *Fraction* of available operational information used in providing CoIs. |
| | | Fraction of options that provide link to underlying information to establish option validity. |
| | Capable | *Number* of options considered/presented from which choice was made. |
| | | Subjective assessment of *correlation* between CoI and favorable operational outcome (1-5 scale: 1 highly, 5 poorly correlated). |
| | Timely | *Minutes/Hours* to generate individual CoI. |
| | | *Percent* of CoI presentations dedeloped within planning timelines. |
| | Usable | *Number/percent* of executable CoIs generated. |
| | | *Number* of CoIs generated that are sent back for rework. |

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| 9.1 Control access to networked resources (hardware and software) and data (both in storage and in transit) through authentication services. | Assured | *Percent* of information/information sources authenticated. |
| | | *Percent* of information/network users with valid access. |
| | Effective | *Instances* of mistaken authorization. |
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| | Flexible | *Number* of authentication types available. |
| | | Ability to add new authentication profiles (yes, no). |
| | Manageable | *Instances* of mistakenly rejected authorization. |
| | | *Number* of steps required to add a new user and grant ac*cess.* |

| | | *Number* of steps required to add a new authenticatin profile*. |
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| | | *Number* of steps required to change a users access. |
| 9.2 Ensure confidentiality by preventing unauthorized disclosure of data (both in storage and in transit), including network data such as passwords, routing tables, etc. | Assured | Management system *conforms* to network security standards (yes, no). |
| | | *Frequency* password changes. |
| | Effective | *Number* of instances of unauthorized disclosure. |
| | | *Number* of instances of compromized passwords. |
| 9.3 Ensure information integrity by preventing unauthorized modification of data, detecting and reporting unauthorized modification of data, and recording all changes to data. | Assured | *Percent* of information systems protected by firewalls, virus detection software or other appropriate defensive IO measures. |
| | | Responsible commands  perform risk assessment of potential threats and take appropriate action to respond to those risks meeting appropriate criteria—*Yes/No.* |
| | | *Percent* of operational information system hardware and software components with replacement components to replace them if they fail or are corrupted. |
| | | Responsible commands have IA or defensive IO memorandums of understanding with commercial communications providers who support information systems—*Yes/No.* |
| | Effective | *Number* of instances of operational information systems being disabled, corrupted or compromised through identified adversary IO actions, criminal mischief or other cause. |
| | | *Percent* of time information systems are disrupted, degraded or out of service. |
| | | *Percent* of disrupted, denied, degraded or destroyed information identified. |
| | | *Number* of instances of disruption, denial, degradation or destruction of information systems identified (due to hostile IO, criminal mischief or other cause). |
| 9.4 Optimize availability to ensure timely, reliable access to data and information services for authorized users by providing protection from attack, protection from unauthorized use, and resistance to routine failure. | Accessible | *Number* of steps required for a user to gain access to data and information services. |
| | Assured | *Percent* of information systems protected by firewalls, virus detection software or other appropriate defensive IO measures. |
| | | Responsible commands  perform risk assessment of potential threats and take appropriate action to respond to those risks meeting appropriate criteria—*Yes/No.* |
| | | Responsible commands have IA or defensive IO memorandums of understanding with commercial communications providers who support information systems—*Yes/No.* |
| | Effective | *Number* of instances of operational information systems being disabled, corrupted or compromised through identified adversary IO actions, criminal mischief or other cause. |
| | | *Percent* of time information systems are disrupted, degraded or out of service. |
| | | *Percent* of disrupted, denied, degraded or destroyed information identified. |
| | | *Number* of instances of disruption, denial, degradation or destruction of information systems identified (due to hostile IO, criminal mischief or other cause). |

| | Timely | *Minutes/hours* for appropriate computer emergency response teams (CERTs) to respond, identify and correct operational information system failures attributed to adversary IO action or criminal mischief. |
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| 9.5 Provide non-repudiation services for all network data information exchanges. | Assured | *Percent* of information exchanges that identify source and user of data. |
| | | Existence of an archive log of all information exchanges (yes, no) |

| | Assured | *Number* of instances of mistaken clearance. |
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| 10.1 Identify clearance of any network node. | Extensive | *Number* of nodes for which clearance is maintained. |
| | Manageable | *Number* of steps required to ID clearance of a node. |
| | | *Number* of people/systems required to maintain clearance ID. |
| 10.2 Track classification of all information. | Assured | *Number* of instances of mistaken classification. |
| | | *Number* of Instances of changed classification that are not tracked. |
| | Extensive | *Percent* of all information that is provided a security classification. |
| | Manageable | *Number* of people/systems required to track information classification. |
| 10.3 Correlate clearance with classification in any situation. | Assured | *Number* of instances in which clearance should have been denied but was not. |
| | | *Number* of Instances in which clearance was denied by should not have been. |
| | Extensive | *Number* of steps required to ID clearance of a node. |
| | | *Number* of people/systems required to maintain clearance ID. |
| 10.4 Control access to information as needed. | Assured | *Number* of people/systems required to maintain clearance ID. |
| | | *Number* of instances of access improperly denied |
| | Extensive | Number of access requests processed per hour. |
| | Manageable | *Number* of people/systems required to control access to information. |
| 10.5 Sanitize or downgrade classified information to lower security classifications as appropriate. | Manageable | *Number* of steps required and permissions needed to downgrade classification of a piece of information. |
| | | *Number* of people required to execute needed declassifications. |

| | Effective | *Percent* of published information not retrieved due to lack of equipment or other interoperability. |
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| 11.1 Interface with different system formats and protocols | | *Percent* of information generated by non-DOD elements not posted to the network. |
| | Manageable | *Instances* of coordination with non-DOD elements significantly delayed. |
| | | *Percent* of translations that require human intervention. |
| 11.2 Incorporate non-DOD elements into joint command and control processes | Accessible | *Percent* of non-DOD support requirements filled at time of execution. |
| | | *Percent* of non-DOD elements that have reviewed plans prior to publication. |
| | Flexible | *Percent* of total network nodes are non-DOD elements. |
| | | *Days* to integrate non-DOD doctrinal differences. |
| | | *Minutes/hours* to establish coordination with State Department, coalition partners and other non-DOD agencies (after establishment of joint force) |
| 11.3 Communicate | Extensive | *Number* of nodes that can participate in managing execution. |

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| Commander's Intent and manage execution across a dynamic and diverse range of potential mission partners | | *Number* of types of activity that can be monitored by each node, by node. |
| | | *Number* of reach-back nodes that participate in execution management. |
| | Flexible | *Number* of types of nodes that can participate in managing execution. |
| | | *Number* of means by which Commander's Intent can be delivered. |
| | Effective | *Collective execution management decisions improve execution (1-5 scale, 1 major improvement, 5 degradation).* |
| | Timely | *Latency* of delivery of execution information (min). |
| | | Subjective determination of whether execution managagemt directions are delivered in *time* to modify execution (expedient, time late). |

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| 12.1 Maintain in any node the ability to perform essential functions autonomously (i.e., without dependence on services provided by other nodes). | Effective | *Number* of required operations that cannot be carried out with local services. |
| | | *Percent* of required functions that can be performed autonomously. |
| | | *Time* increase in performing required functions autonomously, by function. |
| | Sufficient | *Percent* of required capabilities available autonomously. |
| | Usable | Latency in producing required products with respect to meeting decision timelines. |
| | | Increase in *manhours* needed to procuce products. |
| 12.2 Optimize communication with limited or interrupted throughput. | Accessible | *Percent* of local nodes that can switch to locally provided communications. |
| | Effective | *Percent* of information compression |
| | | *Number* of channels that can be used for communications. |
| | Sufficient | *Percent* of required communications that can be accomplished. . |
| | Usable | *Latency* in required communications with respect to meeting due times. |
| | | *Percent* of communications that require manpower intensive utilization. |
| 12.3 Prioritize information requirements so that information is communicated in order of importance when throughput is limited or connectivity is restored | Assured | *Instances* in which lower-priority information is communicated before higher-priority information. |
| | | Assigned priorities are *congruent* with operational requirements (yes, no). |
| | | *Instances* in which high-priority information is delayed/not received because other information is communicated first |
| | Flexible | *Number* of priorities that can be managed. |
| | | Ability to modify priorities depending on the operational situation (yes, no). |
| | Sufficient | Number of available priorities meets operational requirements (yes, no). |

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| 13.1 Monitor network usage and performance | Accessible | *Number* of system performance parameters that can be automatically and periodically monitored. |
| | Extensive | *Percent* of systems for which fraction of time each system is being used can be monitored. |
| | | *Percent* of nodes using the network that can be monitored. |
| | Manageable | *Frequency* of network status reports (number/hour). |
| | | *Automatic* monitoring and status problem alerts (yes, no). |
| 13.2 Manage network services and accounts | Accessible | *Percent* of network accounts that allow access for management. |
| | Flexible | *Number* of types of network accounts that can be managed. |

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| | | *Number* of account parameters that can be managed. |
| | Manageable | *Number* of steps required to make account changes, by account type. |
| 13.3 Identify and diagnose problems in network functioning | Capable | *Number* of instances of network problems not detected. |
| | | *Number* of instances of incorret diagnoses of network problems. |
| | | *Fraction* of instances in which need to intervene in system performance is identified automatically. |
| | Manageable | *Fraction* of network functions that have automatic monitoring and status alerts. |
| | Timely | *Seconds/minutes/hours* to identify need to intervene in system performance. |
| 13.4 Make necessary repairs to ensure effective and efficient network functioning | Capable | *Number* of instances for which needed network repairs cannot be made. |
| | Manageable | *Percent* of instances for which repairs restore services sufficiently to carry out operations in a timely manner. |
| | | *Number* of instances for which human intervention in system performance is required and provided. |
| | | *Percent* of instances for which repair restores full service in a timely manner. |
| | Timely | *Seconds/minutes/hours* needed to repair system. |

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| 14.1 Incorporate new technologies | Flexible | *Number/percent* of new technologies or modifications that cannot be introduced without requiring modifications or new interfaces to existing technologies. |
| | Usable | *Dollar costs* in integrating new technologies with existing systems. |
| | | Number of capabilities gained with introduction of the new technology. |
| | | Number of capabilities lost with introduction of the new technology. |
| 14.2 Adopt new doctrine, tactics, techniques and procedures | Capable | *Efficacy* of new doctrine, tactics, techniques and procedures, based on judgment of users (full, partial, degraded). |
| | | Subjective determination of enhancement of operational capabilities with the new procedures (1-5 scale: 1 significant, 5 degraded). |
| | Flexible | *Days/weeks/months* to introduce new doctrine, tactics, techniques and procedures. |
| | | *Manhours* of training required to utilize effectively the new procedures. |
| 14.3 Modify organizational structure, to accept creation of established and expedient communities of interest's | Capable | *Number* of new organizations introduced. |
| | | *Time* required to establish a new organizational structure. |
| | Effective | Subjective determination of enhancement of operations with introduction of the new organization (improved, no change, degraded). |
| | Flexible | *Number* of structures considered/tested. |
| 14.4. Develop decision makers at all levels that have the skills and temperament necessary to perform effectively in the command and control environment developed by FORCEnet. | Effective | Subjective roll-up of personnel capability measures subsequent to FORCEnet specific training (1 to 5 scale; 1 fully caable, 5 incapable). |
| | | Individual comfort level with FORCEnet processes subsequent to training (fully, moderate, uncomfortable). |
| | Capable | *Time* required for individuals to complete FORCEnet related tasks. |
| | | *Number* of steps in a process timeline with which an individual is unfamiliar. |
| | | Individual can log on to network, enter collaboration session, without assistance (yes,no). |

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| 15.1 Make sense of often-complex situations | Assured | *Fraction* of available information used in the assessment. |
| | | *Number* of pieces of information used in the assessment that come from non-verified sources. |
| | Flexible | *Number* of assessments of the situation considered. |
| | | *Number* of assessments of the situation presented to higher authority. |
| | Sufficient | *Fraction* of operationally relevent variables included in the assessment. |
| | | *Instances* of commander surprised by critical events. |
| | | *Percent* of intelligence judged accurate in light of actual event. |
| | Timely | *Minutes/hours* to assess new information on area/situation. |
| | | *Minutes/hours* since update of situation. |
| | | *Minutes/hours/days* to identify key variables/factors in a situation. |
| | | *Minutes/hours/days* to develop working hypothesis about situation systemic dynamics. |
| | | *Minutes/hours* from receipt of information to complete assessment of situation. |
| | Usable | Degree to which assessment matches decision maker's needs (fully, partially, insufficient). |
| | | *Fraction* of parameters required for the briefing that are provided. |
| 15.2 Make or recommend decisions | Assured | *Percent* of presented options that were considered. |
| | | *Number* of SMEs consulted in decision-making. |
| | Flexible | *Percent* of plans having branches and sequels available. |
| | | *Percent* of courses of action wargamed against projected threats. |
| | | *Number* of options considered. |
| | Sufficient | *Fraction* of forces needed for the operation that are provided direction. |
| | | Completeness of ROI and order-of-battle descritpions (complete, partially, insufficient). |
| | Timely | *Minutes/hours/days* to conceive course(s) of action from time of warning/tasking. |
| | | *Minutes/hours/days* to approve a course of action from time of conception. |
| | Usable | *Latency* of decision with respect to current force deployment. |
| 15.3 Direct or authorize execution action | Assured | *Percent* of units in sufficient contact for timely direction and response. |
| | | *Percent* of staff availabilty to provide needed directions. |
| | Flexible | *Number* of units available that can be re-tasked or re-directed. |
| | | *Fraction* of staff that can provide direction to different unit types. |
| | Sufficient | *Days/hours/minutes/seconds* to respond to requests for guidance. |
| | | *Percent* of addressees receiving direction/guidance. |
| | | *Percent* of available planning time allotted for subordinate planning. |
| | Timely | *Hours/minutes/seconds* to publish changes to orders. |
| | | *Seconds/minutes* for order to be retrieved world-wide. |
| 15.4 Monitor and supervise execution | Assured | Level of verification for reported information (high, medium, low). |
| | Sufficient | *Amount* of information about each unit that can be displayed/assimilated at a time. |
| | | *Fraction* of units for which timely reporting is available. |
| | Timely | Latency of information in *seconds/minutes/hours*. |

| | | *Seconds/minutes/hours/days* to determine a plan will not achieve the required results. |
|---|---|---|
| 15.5 All nodes self-synchronize individual actions based on actions of other nodes in consonance with higher intentions. | Sufficient | *Number* of instances of conflict between unit actions. |
| | | *Number* of instances of poor synchronization between unit actions. |
| | Timely | *Rate* of synchronization updates between units (number/hour). |
| | | *Time* lapse between information updates between units. |

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**Appendix C.  FORCEnet Capabilities to NCOW RM Correlations**

**Table C.  FORCEnet Capabilities and Tasks Comparison to NCOW RM**

| Associated NCOW RM Activities | Major Tasks | Associated NCOW RM Tasks |
|---|---|---|
| **Fn1.  Provide robust, reliable communication to all nodes, based on the varying information requirements and capabilities of those nodes.** | | |
| **A4  Resource Service Requests: Providing the computing, communication and media resources needed to satisfy user requests.** | 1.1 Access the network | A11  Request Access to information Environment<br><br>A13  Create/Maintain User/entity profile<br><br>A33223 Authorize Service/ Capability Access<br><br>A54  Manage  Accounts<br>The NCOW defines "communications" much more narrowly than the Fnet concept. See NCOW A42 - provide communciation resources. |
| | 1.2 Identify all nodes on the network | This task is not listed anywhere in the NCOW RM |
| | 1.3 Publish presence/identity and availability of services on the network | No good correlation to the NCOW RM |
| | 1.4 Publish and subscribe to information on the network | A5323 Manage Publish and Subscirbe Resources.<br><br>A5344 Manage COI Subscription |
| | 1.5 Ensure  network availability and reliability | A3326 Perform Availability Activities<br><br>A52 Manage Systems & Network Configurations |
| | 1.6 Provide sufficient quality of service to all nodes | A52 Manage Systems & Network Configurations<br><br>Various sub-activities to this apply to providing sufficient quality of service to all nodes. |
| **Fn2.  Provide reliable, accurate and timely location, identity and status information on all friendly forces, units, activities and entities/individuals.** | | |
| **A3142  Support Operational Situational Awareness** | 2.1 Report own identity, location, intentions and status on a timely basis | A3142  Support Operational Situational Awareness<br><br>A31321 Provide Tactical nformation Exchange |
| | 2.2 Identify, calculate, report and update positions of non-reporting friendly units | A3142  Support Operational Situational Awareness |

**Fn3.  Provide reliable, accurate and timely location, identification, tracking and engagement information on environmental, neutral and hostile elements, activities, events, sites, platforms, and individuals.**

| | | |
|---|---|---|
| **A3142  Support Operational Situational Awareness** | 3.1 Gain access  (Physical to airspace) | |
| | 3.2 Collect/publish information on environmental, neutral and hostile elements, networks, activities, events, sites, platforms, facilities and individuals | A3142  Support Operational Situational Awareness<br> A31321 Provide Tactical Information Exchange<br><br>There are 6 subactivities to this listed in the NCOW RM that further define what Supporting Op Situational Awareness is.  However, a few other sub-activities under A31-Provide Core Services could relate to this. |
| | 3.3 Provide continuous surveillance of environmental, neutral and hostile elements, networks, activities, events, sites, platforms, facilities and individuals | In the NCOW reference model these ISR functions would be considered inputs to the network and not services performed by the network |
| | 3.4 Provide combat assessment | In the NCOW reference model this ISR function would be considered an input to the network and not a service performed by the network |
| | 3.5 Task and dynamically re-task collection assets via the network | . |

**Fn4.  Store, catalogue and retrieve all information produced by any node on the network in a comprehensive, standard repository so that the information is readily accessible to all nodes and compatible with the forms required by any nodes, within security restricitions**

| | | |
|---|---|---|
| **A31-Provide Core Services and A54 Manage Core Enterprise Services** | 4.1 Store Information | A5321 Manage Content Placement |
| | 4.2 Archive information | A5321 Manage Content Placement |
| | 4.3 Establish data/metadata standards | A53244 Manage Metadata Repositories |
| | 4.4 Establish metadata registries describing structure, format and definitions of data | |
| | 4.5 Catalogue information | A5322 Manage Catalog/Directory Services |
| | 4.6 Retrieve information | A5321 Manage Content Placement<br><br> *In the NCOW the sub-activity A315 Provide Information Storage Services also references this.* |
| | 4.7 All nodes provide information in compliance with standards established in metadata registries | |

**Fn5.  Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.**

| | | |
|---|---|---|
| **A31-Provide Core Services        Parts of this Capability is covered under NCOW RM A314-Provide Information Mediation Services. This refers to information transformation processing, situational awareness support, negotiation and publishing.** | 5.1 Ensure access to raw data before and after any processing | |
| | 5.2 Process data into information (Refers to operating on data using established, routine, and often rote procedures) | A3141 Transform Information |
| | 5.3 Translate information between different systems | A3132 Provide Synchronous Information Exchange<br><br>A3141 Provide Negotiation Services |
| | 5.4 Sort information (Refers to arranging information according to categories or classes, including metadata) | A311 Perform Discovery Services |
| | 5.5 Correlate information over time (A form of sorting referring to chronological sequencing of multiple inputs on the same object) | |
| | 5.6 Deconflict multiple source inputs on single object (A form of sorting that refers to determining whether multiple inputs refer to a single object) | A31421 Correlate Information |
| | 5.7 Analyze information (Refers to studying or determining the nature of a subject, usually by breaking it down into its constituent parts and then describing their relationships each other and the whole) | A314 Perform Information Mediation Services |
| | 5.8 Evaluate information (A form of analysis that refers to judging the significance, worth, condition or reliability of information) | A314 Perform Infromation Mediation Services |
| | 5.9 Identify and predict activity or other patterns | |
| | 5.10 Synthesize information (Refers to combining information elements to form a more complex product) | A314 Perform Infromation Mediation Services |

**Fn6. Provide each decision maker the ability to depict situational information in a tailorable, user defined, shareable, primarily visual representation.**

| | | |
|---|---|---|
| **A31-Provide Core Services** | 6.1 Represent information visually .i.e. imagery, graphical, textual, tabular, schematic, geo-spatial or other form | |
| | 6.2 Represent information aurally | *These tasks are much more specific than the NCOW RM. However, most can be lumped under the activity A3142-Support Operation Situational Awareness.* |
| | 6.3 Correlate elements of visual, aural and other information | A31421 Correlate Information. |
| | 6.4 Represent information temporally | |

| | | |
|---|---|---|
| | 6.5 Integrate friendly, enemy and other information into a single representation | A31421 Correlate Information<br><br>A31422 Fuse Information |
| | 6.6 From a common, universal database, create unique, user-defined situational representations | |
| | 6.7 Develop situation awareness about current conditions, status, implications and plans | A3142 Support Operational Situational Awareness |

**Fn7. Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environment.**

| | | |
|---|---|---|
| **A312 Provide Collaboration Services and A535 Manage Collaboration Resources** | 7.1 Share user-defined plans, visualizations, work products or other complex information products with other nodes, and relate information to others' information representations | |
| | 7.2 Update information products in real time | |
| | 7.3 Integrate/synchronize multiple input modes or media – voice, text, sketch, graphics, geolocation icon, imagery, live feeds, etc. – into a single collaborations session | |
| | 7.4 Provide capability to form distributed teams or communities of interest | A312 Provide Collaboration Services |
| | 7.5 Provide means to collaboratively create commonly-alterable work products or artifacts, such as orders, plans, graphics, analyses, estimates, etc | |
| | 7.6 Integrate diverse mission-planning systems into a single collaborative session | |
| | 7.7 Manage collaboration issues | A312 Provide Collaboration Services<br><br>A535 Manage Collaboration Resources |
| | 7.8 Develop a common understanding of the situation and the command and control work products among distributed groups. | |

**Fn8. Automate lower-order command and control sub-processes and use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations**

| | | |
|---|---|---|
| **No equivelent in the NCOW RM** | | |

**Fn9. Provide information assurance (IA).**

| | | |
|---|---|---|
| **A33 Perform** | 9.1 Control access to networked | A331 Provide Infrastructure Control |

| | | |
|---|---|---|
| **Environment Control Services and several portions of A5-Manage Net-Centric Information Environment** | resources (hardware and software) and data (both in storage and in transit) through authentication services. | Servies<br><br>A332 Enforce Net-Centric environmental policy<br>A52 Manage System & Network Configs |
| | 9.2 Ensure confidentiality by preventing unauthorized disclosure of data (both in storage and in transit), including network data such as passwords, routing tables, etc. | |
| | 9.3 Ensure information integrity by preventing unauthorized modification of data, detecting and reporting unauthorized modification of data, and recording all changes to data. | |
| | 9.4 Optimize availability to ensure timely, reliable access to data and information services for authorized users by providing protection from attack, protection from unauthorized use, and resistance to routine failure. | |
| | 9.5 Provide non-repudiation services for all network data information exchanges. | |

**Fn10. Function in multiple security domains and multiple security levels within a domain, and manage access dynamically.**

| | | |
|---|---|---|
| **Not addressed much in NCOW but is mentioned in A33-Perform Environmental Control Services** | 10.1 Identify clearance of any network node. Authentication. | *Cross domain issues are barely addressed in the NCOW RM. The only references are in A33213-Authenticate Cross-Domain Invocations (this activity only refers to the narrow issues of PKI authentication of Digital signatures) And A5445-Establish Cross-Domain authentication.*<br>A3321 Authenticate |
| | 10.2 Track classification of all information. Confidentiality/Integrity. | |
| | 10.3 Correlate clearance with classification in any situation. Authentication. | A33232 Authorize Data Release |
| | 10.4 Control access to information as needed. Authentication. | A3323 Control Information Flow |
| | 10.5 Sanitize or downgrade classified information to lower security | A33233 Authorize Import/Export of Information |

| | classifications as appropriate. Confidentiality. | A33234 Sanitize Data |
|---|---|---|

**Fn11. Interoperate with command and control systems of very different type and level of sophistication.**

| | | |
|---|---|---|
| **Hardly discussed in the NCOW RM but alluded to in A31 Provide Core Servies** | 11.1 Establish command and control system standards | A3132 Provide Synchronous Exchange Capabilities A31321 Provide Tactical Information Exchange |
| | 11.2 Comply with command and control system standards | |
| | 11.3 Translate between different system formats and protocols | A314 Perform Information Mediation Services |
| | 11.4 Incorporate non-DOD elements into joint command and control processes | |

**Fn12. Allow individual nodes to function while temporarily disconnected from the network.**

| | | |
|---|---|---|
| **Not really addressed in the NCOW RM** | 12.1 Optimize communication with limited or interrupted throughput | |
| | 12.2 Prioritize information requirements so that information is communicated in order of importance when throughput is limited or connectivity is restored | |
| | 12.3 Interpolate/extrapolate patterns based on limited numbers of data inputs | |
| | 12.4 Maintain in any node the ability to perform essential functions autonomously (i.e., without dependence on services provided by other nodes). | |

**Fn13. Automatically and adaptively monitor and manage the functioning of the command and control system to ensure effective and efficient operation and to diagnose problems and make repairs as needed.**

| | | |
|---|---|---|
| **A52 Manage System & Network Configurations and N53 Manage Core Enterprise Services** | 13.1 Monitor system usage and performance | A331 Provide infrastructure control services |
| | 13.2 Allocate and reallocate command and control resources to network services | A33242 Allocate Network Resources |
| | 13.3 Manage network accounts | A54 Manage Accounts |
| | 13.4 Provide and manage core network services | A31 Provide Core Services A53 Manage Core Enterprise services |
| | 13.5 Reroute information based on load, damage, performance, etc. | |
| | 13.6 Identify the need to intervene in command and control system performance | |

| | | |
|---|---|---|
| | 13.7 Diagnose problems in network functioning | |
| | 13.8 Make necessary repairs to ensure effective and efficient network functioning | A524 Recover from incident |

**Fn14.  Incorporate new capabilities into the system quickly without causing undue disruption to the performance of the system.**

| | | |
|---|---|---|
| **Not addressed in the NCOW RM.** | | |

**Fn15.  Provide decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses.**

| | | |
|---|---|---|
| **Not addressed in the NCOW RM.** | | |

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